Data Ingredients: smart disclosure and open government data as complementary tools to meet policy objectives. The case of energy efficiency.

MeTTeG14

Proceedings of the 8th International Conference on Methodologies, Technologies and Tools Enabling e-Government

Udine, Italy – September 25th -26th, 2014

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2014, Universitas Sturiorum S.r.l. - Casa Editrice
via Sottoriva, 9 - 46100 Mantova (MN)
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http://www.universitas-studiorum.it

First edition 2014
Printed in september 2014
ISBN 9788897683636

Preface

This volume contains the proceedings of the eighth International Conference on Methodologies, Technologies and Tools enabling e-Government (MeTTeG'14) hosted by the DIMI- University of Udine, Italy, September 25th -26th, 2014. The conference brings together researchers and practitioners active in the area of electronic government with a focus on the role played by the Information and Communication Technologies. It provides a forum for participants from different perspectives and disciplines to present innovative methodologies, technologies and tools, share experiences and lessons learned from case studies and discuss challenges. Methodologies play an increasingly important role in the management and definition of e-government initiatives. Technologies improve their efficiency and effectiveness while tools allow new specific services and functionalities. The alignment of methodologies, technologies and tools plays an increasing role to enhance the dissemination, accessibility and acceptance of e-government by citizens and companies.

Topics of interest for the eighth International Conference on Methodologies, Technologies and Tools enabling e-Government include (but are not limited to) methodologies (Smart Cities and Smart Communities; One-Stop Government and Services Integration; Better Distributed Services Provision; Enterprise Architectures; Business-IT Alignment Modeling; Agility and Reaction on Change; E-Participation; Pro-Activeness; Greening Government; Open Government and Transparency; Governance and Policy Modeling; Smart and Personalized Inclusion; Legal Informatics and Legal Documents Management), technologies (Mobile Public Services; Cloud Computing; Service Oriented Architecture; Semantic Web Technologies; E-Government Ontology and Metadata; Interoperability and Standards; Knowledge Management and Decision Process Support; Business Processes Management; Web 2.0 for E-Government; Identity Management and Trust; Data and Network Security; PKI Systems; GIS Technologies; Emerging Technologies) and tool (Web Portals; E-ID Systems; Electronic Document Management Systems; E-Voting; E-Procurement; E-Learning; Workflow Management Systems; Open Source Applications; Practices and Experiences; Examples of Public On-Line Services).

Fourteen contributions were submitted to the conference of which eight were accepted and collected in the proceeding. Each contribution was reviewed by well know experts specialized on the conference topics. We are convinced, that the accepted contributions provide interesting viewpoints and good starting points for discussion during the conference. A special issue of the International Journal of Electronic Governance (IJEG) follows MeTTeG'14 and it is devoted to the full versions of invited papers. These papers are subject to a further separate reviewing procedure matching the standards of the journal.

We wish to thank the program committee members and the organizing committee members for their very careful and professional job, and Fabio Chiusi, who accepted to give an invited talk at MeTTeG'14. Thanks also to the authors of submitted papers for their interest in the conference in its first edition. We would like to warmly thank Prof. Dr. Gouscos, Dimitris for having accepted of editing the special issue of International Journal of Electronic Governance. Last but not least, we wish to thank the University of Udine and the Municipal Administration of the City of Udine, for their useful and valuable support.

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NEW FRAMEWORK FOR ELECTRONIC IDENTITY CARDS

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Abstract – In this paper we present a novel framework for electronic identity cards. This framework enhances user privacy, provides accountability and transparency for different actions and transactions between the user and authorities, facilitates peer to peer transactions between two cards and cardholders and enables broadcast encryption. The framework relies on recent advances in cryptography to achieve the privacy of users' identity information. Both identity-based and attribute-based cryptography are used to give the cardholders different ways to authenticate themselves to different services, authorities or even other individuals. Currently, it is not possible to realise all the functionality of our framework in smart cards, but this paper provides a good target for the development of better hardware and software for smart cards. In better resourced devices it should be possible to implement our methods for proof-of-concept purposes.

1. – Introduction

In recent years, many countries have adopted electronic identity (eID) cards to replace and enhance the previously dominant "paper-based" identity card systems [9]. This is thought to increase the possibilities for new services both from government and private sector and to enable citizens to better interact with these in a reliable manner.

The systems in place have varied in their methods to ensure user privacy and different trade-offs have been presented [8]. Some of the deployments have been fairly successful with most of the people adopting and using the new electronic ID cards. In some cases there have been difficulties in making the case for the users and service providers to gain momentum on the electronic ID. One obstacle is also the lack of interoperability or interrecognition between different countries' ID cards. This hinders the adoption of eID cards as users are more and more accustomed to global interactions and thus see the value of the eID systems diminished without near-global acceptance.

Nowadays, different kinds of smart cards have become more effective and are used in various solutions ranging from loyalty and key cards to credit cards and security tokens with embedded input possibilities. The above mentioned eID systems are also an example of the use of smart card technologies. However, many of the ID cards do not utilise the most advanced properties in smart cards. An advanced identity card solution that uses current and possible future features of smart cards has not yet been proposed.

One key enabler for a better identity card system is modern cryptography. It has advanced to new levels and now enables a multitude of different actions in the networked world such as e-commerce, e-voting etc. In some eID systems, digital signatures are possible, but this technology has been available already for decades [4] and is utilised widely on the Internet. Otherwise, the possibilities of more recent advances in cryptography have not been utilised in identity card systems.

One new direction in cryptography has been the advanced methods in identity and attribute-based cryptography [13, 2, 10]. In these systems, the identity or the attributes of the user can be used as the public keys (for encryption and verification) and corresponding secret keys are granted for the user (for decryption and signing). These systems can provide greater flexibility in authentication and protect user's privacy as the identities and attributes can reveal information on several different levels of granularity e.g. full name, age or town of residence.

Identity cards are related to identities, but recent developments regarding the privacy of our online actions has made many stakeholders re-evaluate their view on privacy. This means that there should be solutions that guard the privacy of citizens against different types of surveillance and holds authorities accountable on their actions and access to personal information. Although some of the now active eID solutions offer mutual authentication, it is still not always made explicit and might not be registered by the user or logged by the system in an adequate manner.

In this paper we outline a framework for solving many of the above problems present in modern ID cards. Our framework is based on recent advances in cryptography and could achieve universal interoperability and better privacy than many of the current ID cards. There is also a possibility for peer-to-peer authentication and other features that require also some advances in technology. The paper is organised in the following way. In the next section we outline some previous ID card solutions and the methods that these employ. In the third section, we give a brief background on the theoretical foundations of our work. In the fourth section we describe our new framework. The fifth section contains discussion on our proposed framework and in the final section we give our conclusions.

2. – Previous Solutions

There are several ways to tackle the identification problem in an organisation or a nation state. In many cases, some sort of a card has been issued with some identifying information on that card such as a name, a picture etc. The issuer usually depends on the level of applicability that the ID card is supposed to have. For example, in many workplaces there are ID badges issued to employees, but these are usually not applicable outside the organisation in question. On the other hand, in many places a valid driver's licence is accepted as an ID card. Some countries have also national ID card schemes that can be compulsory or voluntary. Also passports are usually accepted as valid proofs of identity in several countries. Even foreign passports may be accepted, or driver's licences or some other cards that are deemed official by the authorities. However, the rules and customs vary greatly between different countries and sometimes even within a country.

In recent years, there has been a rollout of electronic ID (eID) schemes in several countries [9]. The idea is that these new ID cards would help the government to provide services over the Internet. These services include a variety of both low and high security services. Thus, good verification of ID is needed for some e.g., electronic voting, tax and medical information. In other cases, even less reliable verification can be used to access less critical information or service.

In other uses, smart cards have been more actively deployed. Different types of security tokens and tickets have been fairly popular in many application environments. One of the more advanced versions is the Taiwanese EasyCard[1] system, which allows access to many different services with the same card. This type of a multiple use card can then appeal to a wider population. Also credit and debit

[1] See http://www.easycard.com.tw/english/index.asp for more details.

cards are nowadays equipped with chips to enable chip and PIN authentication. More advanced credit cards have even embedded displays and numeric pads.

Also passports in several countries are nowadays equipped with smart chips for storing for example biometric information that can be used in automated border-crossing. The use of this information in other contexts has not been very widely adopted. Thus, one might not be able to use the passport as a full eID in many applications.

3. – Theoretical Background

Our new proposed framework relies on some advances in modern cryptography. The theoretical details of many of the systems are quite involved and thus cannot be presented here in full. We give a fairly high level overview of the methods that are to be used and the theory behind these. Then we will describe the main features and capabilities of these methods.

Public key cryptography (PKC) has already a very good and proven track record in solving some of the problems related to communication over the Internet. The main idea is that instead of a single secret shared by both communicating parties, there are two keys, public and private, and the former can be made public and only the private needs to be kept secret. With the help of the public key, one can encrypt messages and verify signatures made with the corresponding secret key and with the secret key one can make signatures and decrypt messages encrypted with the corresponding public key.

One problem in PKC is the reliable way of sharing the public keys between two unacquainted parties. Usually this is done via certificates, but this system has its drawbacks and the trust to certificate authorities has been undermined by some recent revelations. One possible solution is provided by *identity-based encryption and signatures* (IBE and IBS respectively). In these systems, the identity itself acts as the public key and a corresponding secret key is computed from this information. The identity can be any piece of information such as an email address, name or even a social security number.

The idea of IBE has been extended to *attribute-based encryption and signatures* (ABE and ABS, respectively), where the identity is replaced by a set of attributes that the user has. These systems ensure a higher level of privacy as the verification of a signature only reveals that the user belongs to a certain group of users that satisfy the required claim on the attributes, e.g., 30-year old male resident of Albuquerque.

The methods of IBS and ABS enable our vision of a new framework for eID cards. However, there are even more advanced methods that can be utilised such as functional encryption [3] and even homomorphic encryption [6]. These methods would enable also a wide variety of other applications than ABE and ABS, but are not yet efficient enough for applications in smart cards. This might also be a problem with some of the most advanced ABS methods at the moment.

Currently, there are many different methods that provide ABS and ABE. One of the key differences between different methods of ABS and ABE is the need of a central, trusted party. For example, in [12] there is a need for a trusted central authority issuing the attributes (or attribute issuing keys) whereas in [10] such authority is not required. Some methods offer also further benefits, such as threshold ABE [12], where one can set a threshold for the number of attributes that need to match for a given signature to be valid.

Different types of electronic identity cards have been issued by many countries. In the EU there has been a fairly keen interest on these and especially the interoperability between the eID cards of different nations. The STORK 2.0 [1] builds upon the previous STORK project and includes participants from 19 countries. In the documentation of the project one can see a wide variety of different approaches and uses for eID cards. One interesting aspect is the definition of the Quality Authentication Assurance (QAA) levels, that provide indication of how trustworthy the eID's information about the user is. This is one aspect that should be further refined and taken into account in authentication contexts also elsewhere.

4. – The Framework

In this section we describe our proposal for a new eID framework. The main idea of our proposed framework is presented in Fig. 1. The main features are the following:

1. The framework facilitates the use of several different identity and attribute providers.
2. The framework provides accountability of the access to personal information stored on the card via logging functionality.
3. Two cards can perform authentication between each other i.e. peer-to-peer functionality without extra readers.
4. The cards can contain attributes of varying QAA levels. This level is to be linked with the attribute and always used in conjunction with that attribute or identity.

With the help of the first feature each user can have a wide variety of attributes or identities that are provided by several different identity and attribute providers. Thus, the service provider asking for authentication with some credentials does not need to rely or trust any single central authority to provide the attributes, but instead can choose which provider it trusts. The user can then prove the identity or possession of the attribute if the identity or attribute has been provided by a provider trusted by the service provider.

The use of attributes also makes it easier to authenticate users and transaction only on the minimum level necessary. This means that the privacy of users is better protected as only some attributes of the user are revealed instead of the full identity. Together with the accountability feature, this should protect the users from many possible abuses. The user is also always informed about the attributes that are required to authenticate for the service.

The accountability feature needs some reliable storage both on the card and in some outside service. In an ideal case, there would be several possible places where the user can choose to store this data. The systems should be interchangeable and decentralised. However, more likely scenario is that some central authority collects a repository of the transactions. In that case, very strong precautions should be made to ensure the immutability and integrity of the records.

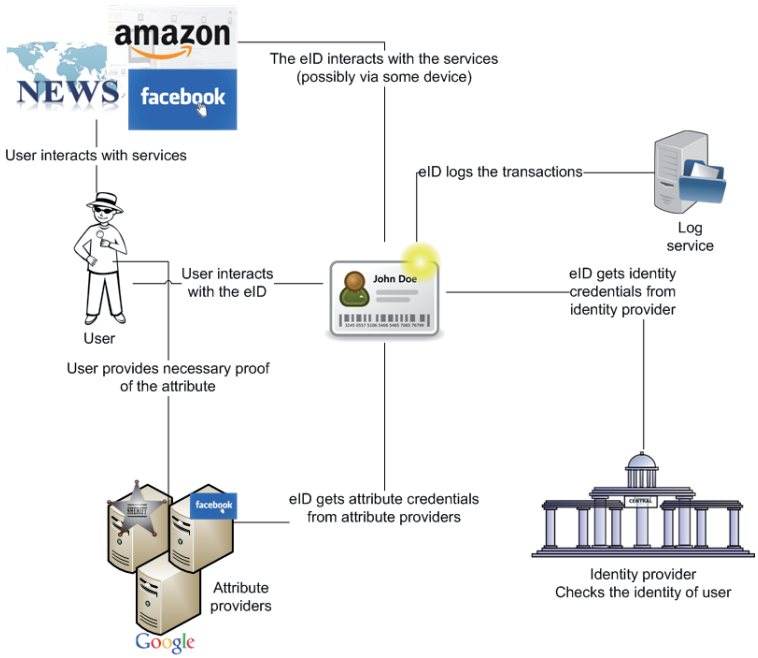

Figure 1 Our framework

The peer-to-peer functionality is necessary to provide the users with the possibility of strong authentication in transactions conducted between them. This could mean the verification of identity when buying and selling a used car or other common transactions that occur between two ordinary citizens. In many of such cases, being able to reliably authenticate the other party would help in making the transaction more trustworthy.

As the users may acquire attributes from different attribute providers, it is essential that the level of trust i.e. the QAA is linked with the attributes. Thus, service providers can make decisions on what level of attribute verification they require for their services. In the following we discuss some of the key points of our framework in more detail and present different options or methods of arranging these in our framework.

4.1. – User Authentication

In this section we discuss the authentication of the user towards the eID in order to gain access to the attributes included in the card. The total authentication of the user towards the service and the authentication of the user to attribute and identity providers is not in the scope of this paper. The former can also include components outside of the attributes and identities in the eID card and the latter is a more of a matter of policy of the issuing organisation.

We distinguish between two different scenarios for authenticating the user to authorise the use of the credentials stored on the smart card. First we have offline authentication, where the user authenticates herself to the card locally with some method (or a combination of methods) such as PIN, biometric, password or implicitly with the context. This local method of authentication would be preferable as this is essential in enabling the peer-to-peer functionality of the eID cards.

The second option is online authentication, when the smart card acts merely as a storage vessel and signing platform for the attribute credentials and does not have any functionality to interact with the user. In this case, the authentication is conducted online with the help of card readers, computers etc. The user authenticates via the help of the reader and the card interacts with the reader to provide the necessary signatures. This makes the peer-to-peer functionality harder to accomplish and to use in cases where there is no network connectivity.

4.2. – Attributes and Identities

Different attribute authorities can grant sets of attributes for the user as defined in the attribute-based signature system. Even different systems may be in se at a time as long as there is a protocol for negotiating, which systems to use, when authenticating with attributes.

Attribute authorities should have some procedure for verifying the attributes. Thus, gaining attributes from some authorities may only be possible on site i.e. by personally visiting the authority and providing proof for the attribute(s). Others may grant attributes online via some other procedure. This procedure should be public knowledge, so that service provider can know how much they can trust the attributes of a given authority. Different QAA levels can convey this information to service providers and other users.

As the card is an eID card, there should also be some identity-based secret keys stored on the card. This would require another infrastructure for identity-based encryption for IBS. However, this could be based on same mathematical principles and thus would not require much different hardware or software in addition to the attribute-based cryptography. It could be possible to make the differentiation only at protocol level. In any case, with a sufficiently powerful smart card, both systems could co-exist in the eID card.

4.3. – Using Attributes or Identity for Authentication

The use of the card after the user has authenticated towards the card is pretty straightforward. As per the chosen system, the user will make signatures with respect to some predicates related to different attributes or with some identity. If some form of an identity is needed, the user can use any of the identities stored on the card. These could be different types of identities, e.g. full name or social security number again authorised by different authorities.

The signature generated by the card with the help of the user is then provided to the service or other entity that has requested the information. The request should be signed with an identity or a set of attributes that is visible to the user receiving the request. This information is also included to the user's log to provide accountability for the different transactions and requests.

One possible use of this framework could also be attribute-based broadcast messages that are only decryptable by users with the required attributes [7]. These could be used for public service

announcements or other similar types of dissemination of information that is only relevant to some well-defined subset of the population.

The attributes and identities could be either hidden or displayed to the re- questing party. The default should be that the attributes remain hidden and only True/False answer should be provided. However, in cases where the user agrees that the information can be revealed, the value of the attribute should be displayed. With identities this distinction is rather moot, as the signatures themselves already confirm the "exact" identity of the user.

4.4. – Required and Optional Functionality of the Smart eID Card

To enable all the benefits of the new framework, there are some requirements for the smart card. First of all, it should have enough processing power to compute the IBSs and ABSs on the card. Furthermore, the card should contain methods for authenticating the user, before the access to the stored attribute credentials is granted.

One important feature of our framework is the possibility of two cardholders to authenticate their attributes with only their cards to each other (or between the cards). This is depicted in Fig. 2. The two users engage in some transaction that requires the verification of some attributes or identity of one or both parties to each other. Thus some wireless, close-range connectivity is a requirement for the full-fledged eID card in our framework. Once the connection between eID cards is established, the users interact with the card to accept or reject the requests for information. When accepted, the other eID card would display that the transaction was completed successfully and could display the requested attributes and/or identity of the other party, if this has been agreed on.

To provide good accountability there is a need for logging the transactions. As some transactions might be made without access to outside network, there should be some memory to allow buffering the log on the eID card itself. When a connection to the outside log service is established the transactions should be logged there (as well as any buffered transactions). As this log of transactions is extremely important there should be heavy safeguards to ensure that the log cannot be tampered with or destroyed permanently.

5. – Discussion

Although our proposal is based on existing theoretical results in cryptography, there are still many technological challenges in making the framework working in real life. Most of the required functionality can already be found in mobile phones and thus prototyping the solutions should be fairly easy. However, it is our opinion that a dedicated device such as a smart card (of sufficient capabilities) would be preferable over a multi-purpose smart phone as the platform for the smart ID card. It would enable more rigorous security design of the hardware and software and could be made especially for the attribute- and identity-based infrastructures in mind.

As there are many advances that need to be achieved, it should be possible to move forward in a iterative fashion, one step at a time. Also different parts of the framework can be developed independently as advances in more effective cryptographic methods, better hardware and sensors etc. all contribute to the end result. Our proposal is not the pinnacle of evolution in ID cards and more advances can provide better solutions and more options. For the authors, something in the line of

gevulot from the science fiction novel The Quantum Thief [11], would be near perfection in identity and privacy management.

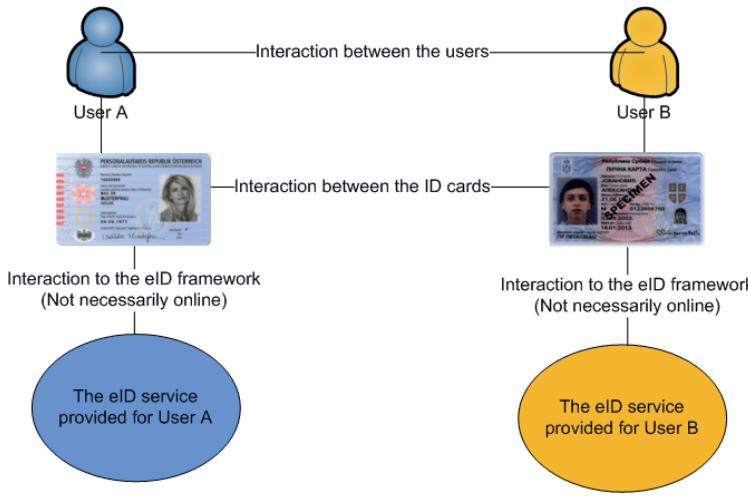

Figure 2 Peer-to-peer functionality

Future research should provide more efficient cryptographic methods for conducting this type of authentication. Also it might be interesting to research methods that could infer some attributes from biometrics or the context of the card. For example, recognising the age of a person from a facial image has been researched and also mood can be inferred for example with the SHORE software [5].

With ID cards, identification and authentication one cannot avoid considering the legal issues related to the access to the information on the ID card or the use of the card itself by some authorities. These are multifaceted issues that lie beyond the scope of this paper. It is worth noting, that the cryptographic methods on attribute-based signatures provide anonymity in the sense that no information about the signer is revealed except the publicly verifiable fact that the signer's attributes fulfill the given assertion.

Some development to achieve better interoperability of different countries eIDs has been done in the STORK 2.0 project [1], where European stakeholders are trying to solve the interoperability and the user privacy and usability challenges. The project envisions a common European identification and authentication area. However, it builds on existing eIDs in several EU countries and thus contains in some cases the limitations that are present in the given countries eID schemes. Our framework could overcome these obstacles and facilitate even global interoperability that would be only limited by the different trust relationships between the stakeholders.

6. – Conclusion

In this paper we have presented a novel framework for electronic ID cards. The framework is based on existing cryptographic techniques in identity- and attribute-based cryptography. However, there are

technical hurdles to be overcome in realising this system. The framework provides better privacy for the users as they do not unnecessarily and without explicit consent need to reveal their identity information. Instead, different attributes are granted to the user and users can sign several kinds of assertions on these attributes with their ID card. Furthermore, the framework facilitates peer-to-peer interaction with the cards and also grants the holders of the ID cards methods for keeping track of the different interactions. This also increases the accountability of authorities such as the police that can conduct checks on peoples IDs.

Acknowledgement

The authors would like to thank the SASER-SIEGFRIED Celtic Plus project and Tekes, as the national funding agency for supporting this research.

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DATA INGREDIENTS: SMART DISCLOSURE AND OPEN GOVERNMENT DATA AS COMPLEMENTARY TOOLS TO MEET POLICY OBJECTIVES. THE CASE OF ENERGY EFFICIENCY.

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Open government data are considered a key asset for eGovernment. One could argue that governments can influence other types of data disclosure, as potential ingredients of innovative services. To discuss this assumption, we took the example of the U.S. 'Green Button' initiative – based on the disclosure of energy consumption data to each user – and analysed 36 energy-oriented digital services reusing these and other data, in order to highlight their set of inputs. We find that apps suggesting to a user a more efficient consumption behaviour also benefit from average retail electricity cost/price information; that energy efficiency 'scoring' apps also need, at least, structured and updated information on buildings performance; and that value-added services that derive insights from consumption data frequently rely on average energy consumption information. More in general, most of the surveyed services combine consumption data, open government data, and corporate data. When setting sector-specific agendas grounded on data disclosure, public agencies should therefore consider (contributing) to make available all three layers of information. No widely acknowledged initiatives of energy consumption data disclosure to users are being implemented in the EU. Moreover, browsing EU data portals and websites of public agencies, we find that other key data ingredients are not supplied (or, at least, not as open data), leaving room for possible improvements in this arena.

1. – Introduction and objectives

Data are said to be the fuel of the digital economy [1]. Within the scope of their institutional mission, public agencies collect and manage, on a permanent basis, huge amounts of information [2] [18]. Since at least the late Eighties, information disclosure by public bodies has also been conceived as a tool to generate economic growth [3], and improve government transparency [4]. In fact, ensuring a wider circulation of digital information is one of the pillars of eGovernment strategies, from the EU Digital Agenda [5] to the G8 Open Data Charter [6]. Public data are considered key ingredients to create value-added services by third parties especially where their publication is 'demand-driven', and their reuse is enabled by intermediaries [7]. One could argue that specific policy objectives can be better tackled by making available further information layers beyond open government data. To discuss this hypothesis, we take the example of the U.S. 'Green Button' initiative – based on the disclosure of energy consumption data to each user – and analyse innovative applications stemmed from it, in order to highlight their (public) data ingredients.

This paper has the objective to contribute verifying -trough a specific example- to what extent digital applications stemmed from government-enabled disclosure of information rely on a diversified set of data inputs, which are those inputs, and by whom they are held (e.g., different public actors, but also private players). In this way, we highlight the minimal set of openly disclosed information needed to actually make these digital services viable and useful for the public. In this vein, we consider a specific

policy initiative, i.e., Green Button; analyze its functioning; propose an evaluation framework of the Apps derived from Green Button (e.g., winners of Green Button-based public competitions); derive results, in terms of typical data ingredients of those Apps; and start discussing about whether these data ingredients are currently openly available in Europe. See more in the methodological section of the paper (p. 5 and ff.). All source data, including links to the evaluated Apps, are stored and available in a separate file (Google spreadsheet).

The remainder of this paper is organised as follows. Section 2 compares government-driven data disclosure paradigms. Section 3 describes Green Button. Section 4 presents our analysis of energy-related applications in the U.S., highlighting their data ingredients. Section 5 discusses to what extent the same initiative could be implemented in the EU. Section 6 wraps up, identifying further research questions.

2. – A map of government-enabled data disclosure

Not all information held by public agencies is publicly available. Depending on the jurisdiction, constraints may arise, e.g., related with data protection, copyright, security, but also insufficient budget, and discretionary decisions of data holders. Also, not all publicly available governmental information is actually reusable, e.g. for technical reasons (such as 'closed' formats). 'Open government data' can be defined as information originally produced by public agencies that "anyone is free to use, reuse, and redistribute", "subject only, at most, to the requirement to attribute and/or share-alike" [8] [9].

Governments can influence other types of data disclosure as well. It is the case of the so-called 'smart disclosure' of consumption data, i.e. "the timely release of complex information and data in standardised, machine readable formats in ways that enable consumers to make informed decisions" [10]. Typically, product-attribute information [11] [16] [22], but also, more recently, information describing the actual consumption patterns of a user [12] [17]. This approach might fill a gap since, as argued by some scholars, consumers are not keeping records of their own consumption [13]. Governments can encourage smart disclosure by setting standards, engaging industries, and issuing regulation [14]. Governments themselves collect consumption data (e.g., when providing health or education services). Downstream, value-added applications can be created, improving market transparency, enabling switches, and providing incentives for more efficient consumption; all meeting important policy objectives.

As a third point, private companies are starting disclosing open data (in some cases called 'open corporate data' [15]), as a further layer of information to be be reused.

Table 1 reports a comparison between the three aforementioned paradigms. For the scope of the article at hand, what seems to matter is that, used jointly, different types of data may serve the same purpose. For example, to enable consumer switching, one needs, at least, actual energy consumption data of a user over a relevent period of time, information about buildings efficiency (to set the benchmark), and energy utilities rates. These three layers of information are disclosed by different actors, and refer to different paradigms: smart disclosure, open government data, and open corporate data respectively. Thus, to enable the aforementioned service, governments should contribute addressing the three aspects.

	Open government data	Smart disclosure	Open corporate data
Example (in the energy field)	Dataset reporting energy efficiency levels of buildings in a given area.	Granular personal consumption patterns of a single consumer served by a specific utility.	Accounting data of a energy utility company.
Government role(s)	Identifier of the opportunity; regulator; direct promoter.	Identifier of the opportunity; challenger for the industry; direct promoter (where industries are regulated).	Challenger for the industry.
Prominent objectives	Government transparency and accountability; economic growth.	Consumer empowerment; market efficiency.	Corporate accountability; corporate social responsibility.
Drivers for the promoters	Policy agenda; competitive regulation; preserving credibility towards citizens; direct benefits from new services.	Regulatory constraints; improved reputation; increased knowledge on consumer behaviour; consumer retention.	Regulatory constraints; improved reputation; opportunities of collaboration with third parties.
Prominent technical aspect(s)	(Legal and technical) interoperability; standardisation of data formats; quality of service.	Standardisation of data formats; quality of service.	(Legal and technical) interoperability; standardisation of data formats.
Publication means	*Erga omnes* through open data portals, as static datasets, linked data (e.g., RDF), and/or open data services (e.g., via APIs).	To each consumer as static files (eg., XML), and/or as dynamic data via APIs.	*Erga omnes* through dedicated websites, as static datasets, linked data (e.g., RDF), and/or, open data services (e.g., via APIs).
Prominent legal/regulatory aspect	Intellectual Property Rights (including database rights); previous agreements with third parties.	Privacy and data protection; competition.	Intellectual Property Rights; privacy.

Table 1: Complementary paradigms of data disclosure promoted/enabled by governments

Benefits of open government data can be identified both internally and externally public bodies. On the one hand, by opening up information, highly fragmented public administrations can overcome the problem of having information only flowing vertically, and rarely between departments, also harmonizing the way information is expressed [19]. On the other hand, open government data can increase transparency of organizations [20], and enable business-oriented reuses [21].

Although they may serve similar purposes, the main differences between open government data and smart disclosure of consumption data are typically the following: i) data granularity; open government data are usually aggregated and disclosed to everyone, while smart disclosure relates with making available to each consumer her own, fine-grained, consumption data; ii) role of the government, which is directly publishing data in the first case, and typically (only) enabling disclosure in the second. As highlighted in the Table, these differences might have an impact, e.g., in legal aspects, such as data protection, and licensing schemes.

3. – Smart disclosure of energy data: the case of Green Button

Green Button is an initiative promoted by the U.S. Department of Energy in 2011, aimed at disclosing to energy customers their digital consumption data. The U.S. Government defined guidelines and standards for data publication, directly engaged with energy utilities to make them adopt common practices, and set the stage for the creation of applications grounded on Green Button data, e.g., through public competitions. In fact, Green Button is said to be “government inspired” and “industry led” [23]. As of early 2013, 58 energy utilities serving around 36 million customers implemented or committed to Green Button [24].

3.1. – From smart metering ...

Let's make a short step back. With no doubt, at policy level, energy consumption is a topic of strategic importance. Roadmaps set by governments, including supra-national institutions, aim at rationalising energy usage, and re-balancing its mix in favour of the so-called renewables [25]. A deeper analysis of these dynamics goes beyond the scope of this paper. However, we should note that data play a key role in understanding and influencing energy consumption [26]. This is arguably true for many reasons, amongst which the fact that electricity and gas for residential and commercial purposes is a widespread commodity in developed countries; and that efforts towards data standardisation and collection have been produced since decades. 'Smart meters' allow energy utilities to gather fine-grained consumption data from users, by "identify(ing) consumption in more detail than conventional meters and communicat(ing) via a network back to the utility for monitoring and billing purposes” [27], while 'smart-grids' are “a future electricity distribution network that saves energy by matching distributed generation resources intelligently with demand” [28].

Motivations for energy utilities to adopt smart metering mostly relate with better assessing customer behaviour, so to manage load balance more effectively, by encouraging users (e.g., through price discriminations) to reduce consumption during peaks. Improved network management, and fraud detection are other drivers [29]. Governments encourage and enable these kinds of practices mainly because they are supposed to foster energy efficiency [29]. Utilities might also have disincentives in rationalising users' consumption, trivially because this would entail less revenues. In regulated markets, policymakers can mitigate this effect by using several practices, including revenue decoupling, which makes utilities revenues unaffected by the quantity of energy delivered in the retail market [30]. Interestingly, other players beyond the usual suspects have started serving utilities by providing real-time data gathered from thermostats and other devices, enabling demand-response actions, as in the case of Nest, recently acquired by Google for $3.2 billion [31].

3.2. – … to smart disclosure

When it comes to sharing granular consumption data also with consumers, incentives for a utility might be weaker, and mostly depending on its market share, as well as on the market itself, that can be regulated (thus, protecting incumbents to some extent) or not. Users might find it profitable to have their consumption data available, since this could grant the opportunity to benchmark their consumption against others, and, in general, to reduce switching costs. Some scholars show that energy savings from more efficient behaviour – e.g., enabled by smart disclosure – are usually low (e.g., if compared to overall recurrent expenditures of householders). However, savings tend to be stable over time [32]. Further anecdotal evidence indicates that some consumers explore the potential savings but do not switch, revealing a gap between their perceptions of potential savings, and switching costs [33].

Governments might therefore want to contribute to the issue by introducing credible incentives for utilities to disclose fine-grained consumption data. This objective can be achieved by a mix of coercive and mimetic drivers, including moral suasion [24], but mainly by defining a common legal and technological ground. Which means, agreeing on, designing and adopting a shared schema for data publication.

In fact, Green Button takes as a reference the Energy Services Provider Interface (ESPI) schema, developed by the North American Energy Standards Board. In a nutshell, ESPI encompasses three types of actors: the 'data custodian', i.e., an energy distribution company; the 'user agent', i.e., a retail consumer; the 'third party', i.e. a subject allowed to access a user's data to develop applications.

In this framework (as depicted in Illustration 1): energy utilities structure and disclose information using the ESPI standard; consumers can periodically get their consumption data in xml format, with prerogatives to share it with third parties; developers can elaborate data through direct user upload, or, with user's consent, connect with her utility to retrieve data via APIs made available by Green Button. Standardisation was then applied to data themselves, which are designed to be released as timely, complex, machine-readable, interoperable, and privacy-compliant information on consumption. Any xml parser can be used to analyse the data structures represented in xml according to the ESPI scheme, that contain structured information about meter readings (including usage point, service cateogry, time interval and other time parameters, as well as the reading itself, including metadata[1]).

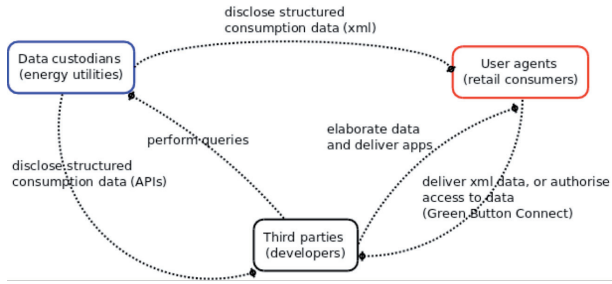

Illustration 1: Green Button functioning (using ESPI scheme)

4. – (Public) data ingredients for energy applications

4.1. – Methodological approach

We selected 17 applications reusing Green Button data emerging as winners (or shortlisted) in two major U.S. contests, i.e. the Energy Challenge (2013, awarding $100.000 in prizes) and AppsForEnergy (2012, awarding $100.000 in prizes). For each application, we gathered structured information on the objective, the tasks performed, the way Green Button data were embedded, and the set of other public (and/or proprietary) data used. To do so, we performed desk research, and submitted queries to the apps creators, gathering 6 responses.

[1] See example at http://www.greenbuttondata.org/data/15MinLP_15Days.xml.

As a complement, we also considered 19 applications grounded on energy data reuse as exposed by OpenData500 (a U.S. web portal presenting 500 interesting cases of open government data reuse), mainly to check which applications were also using Green Button data, and, in general, to assess their data ingredients as well.

Comparison had as main objectives to highlight what types of data elaboration of smart disclosure data are the most recurrent in the example of the Green Button energy data, and which other public or proprietary data are used for each type of application. Comparison criteria were selected by combining relevant sources of information in literature, related in particular with archetypal business models (or activities) applied to public sector information, as in the cases of [21] and [12]; and the taxonomy of possible reuses of Green Button data provided in the official documentation. Final criteria therefore encompassed: i) basic data describing the App (e.g., name, link, short description); ii) information about specific features (e.g., whether the App directly represents an efficiency driver for the user; whether social features are provided); iii) information about the way data is retrieved from Green Button (e.g., whether the 'GreenButtonConnect' service is used); iv) the other sources of data used as input, especially from public administrations (e.g., data on buildings efficiency);

Primary data gathered are available in a structured Google spreadsheet: https://docs.google.com/spreadsheets/d/1dWvCPLVXciFBrvhAoPPv8mV0meFBYKXt9E8Q0GALSXA/edit#gid=1700120865

The spreadsheet includes links to demos of the Apps, or, where available, to the Apps themselves (column 'Link' in the '1-Apps' tab).

4.2. – Empirical analysis of energy apps: main results

Based on the Green Button taxonomy and on our observation, we divided the 17 Green Button-based apps of our sample in three categories, based on their prominent purpose: suggesting efficiency-improving changes in the consumption behaviour of their user (“Enabling consumption choices”); benchmarking and scoring residential energy efficiency (“Scoring”); deriving trends and hints from consumption data (“Creating insight”). Of course, strong overlaps can be identified between categories, suggesting that other categorisations are obviously possible.

All apps in this sub-sample perform some kind of data analysis and integration. 82% of them are also relying on at least one open government data source as a key ingredient. Table 2 reports, amongst other details, the most used governmental data sources. In general, as complementary sources, we identified a recurrent use of the following datasets: average energy consumption per zone , buildings performance , average retail electricity cost/price , commercial energy offers in unregulated markets , buildings energy certificates , and information on available energy incentives , but also authoritative sources that can be used as reference for many different applications, such as census / demographic information , and meteorological information .

Starting from the available evidence, we contend that apps suggesting to a user a more efficient consumption behaviour also benefit from average retail electricity cost/price information; that energy efficiency 'scoring' apps also need, at least, structured and updated information on buildings performance; and that value-added that derive insights from consumption data frequently rely on average energy consumption information. All information should be consistent, complete, timely released and updated. Also, proprietary data (such as data from sensors) represent potential sources of competitive advantage.

Type of Green Button-based app	Enabling consumption choices	Scoring	Creating insight
Number of apps in the sample	**8**	**4**	**5**
Most used open government data	Electricity cost/price data (3)	Buildings performance data (2)	Average energy consumption (2); Weather data (2).
Most used proprietary/other data	Real estate data (3) Utility rates (2)	(none)	
Also retrieving data via utilities' APIs - occurrences	2	2	1
Enabling social interaction between users – occurrences	3	2	1
Directly providing incentives for efficiency (e.g., rebates) - occurrences	6	3	3

Table 2: Green Button-based apps (n=17), May 2014

To support the assumption that data mixes matter, we take the interesting example of the WattBuddy app (also summarised in Illustration 2). WattBuddy tracks Green Button data (either as xml file, or as a scan of the electricity meter), plots historical usage, and provides competitive offers in deregulated markets (to date, Pennsylvania and New York). To do so, it pulls from both granular and general data sources. The Building Performance Database lets choose from about 200K U.S. buildings using age, size, number of occupants, etc., and shows us the annual electricity usage for that cohort. A database maintained by the Energy Information Administration provides the average electricity cost per area, which is used to assess current expenditure. Besides, WattBuddy uses commercial offers in deregulated states, which is not a national dataset. Also, it is grabbing from Zillow (database of real estate data) the specs of the particular house, so to allow benchmarking.

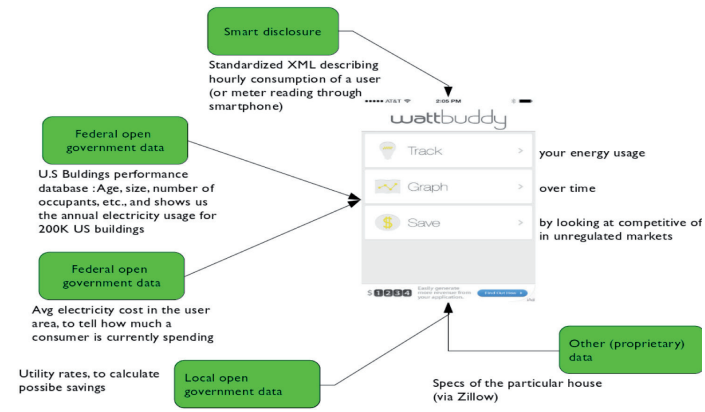

Illustration 2: WattBuddy app data ingredients

As a complementary question, we could ask ourselves how many energy-related apps in the 'Open Data 500' database are also using consumption data (i.e., from Green Button). Looking at 19 apps tagged as 'energy-related', 7 are using fine-grained consumption data. We also learn that the data mix is more heterogeneous than in the previous case; still, utility rates, which are currently available as open data only in two States of the U.S. (while, in other cases, apps retrieve them directly from utilities, e.g., through specific agreements), appear as an important ingredient (if compared to others).

4. – How far are we in the European Union?

We provide a tentative answer to this question in two ways. We assess whether the government data previously identified as the more used in energy-related applications are openly available in the EU; and we start checking whether relevant legislation already supports energy data disclosure.

As for the first point, structured data are reported in sheet #7 of the already mentioned attachment (see p. 5), and a summary is presented in Table 3. We performed queries in the EU, Italian and UK data portals, also checking data availability in public agencies. Making available commercial offers in unregulated markets is probably the most relevant gap to be filled in order to enable value-added services performing comparisons based on actual consumption data; yet, barriers in disclosing this kind of data could be high, mainly in light of their strategic importance, but also because data are held by several different players, perhaps formalised in such a way that makes it tricky to integrate them in a single database. One should add that, even in the cases in which data are supplied, their expected frequency of update is seldom advertised, while timeliness is arguably a key feature enabling an effective data reuse by businesses.

	USA (Federal agencies)	**EU (Open Data portal, Eurostat, EU agencies)**	**Italy (Open Data portal, national agencies)**	**UK Open Data portal**
Energy consumption	.csv	DFT, SDMX-ML, TSV	.csv, SDMX-ML	.csv, .xls
Buildings performance	tabular (API queries available)	**poor match**	**no match**	.pdf
Electricity cost/price	.xls	.csv, .xls	.html (**poor match**)	.pdf
Commercial offers in unregulated markets	available only in two States (as tabular data)	**no match**	**no match**	**no match**
Census / demographic information	.csv	.csv, .xls	csv, SDMX-ML	.csv, .xls, .html
Weather data	.xml via RestFUL APIs	ASCII	csv, SDMX-ML	RDFa
Buildings energy certificates	single queries	**no match**	.csv	**Existing, but unpublished**
Energy incentives	OpenXML; JSON	**no match**	.xml	.xml

Table 3: Energy open data availability in the EU (indicating data formats), as of May 2014

As far as regulation is concerned, several EU directives and strategic documents set requirements to meet energy efficiency objectives, also introducing new tools to push forward the agenda. E.g., the Energy Services EU Directive (2006) [34] specifies that energy operators should provide "aggregated statistical information on their final customers to the authorities", in order "to properly design and implement energy efficiency improvement programmes " (Article 6). The same directive provides that several pieces of information are periodically made available to users, including, but not limited to, "current actual prices and actual consumption of energy " and "comparisons with an average normalised or benchmarked user of energy in the same user category". The Energy Performance of Buildings Directive (EPBD) 2010/31/EU [38] is aimed at fostering energy efficiency in buildings across Europe by promoting cost-effective decisions, also harmonising practices through Member States. The Directive prescribes that all new buildings must be characterised by high energy-performance standards. The 2009 EU internal market in electricity directive [35] prescribes measures for consumer protection, including information sharing. Amongst a broad set of prescriptions, the 2011 EU Directive on consumer rights [36] calls for disclosing product-attribute information. Specific smart disclosure-oriented regulation in the energy field is not yet present. However, one may note that national policy initiatives, such as MiData in UK [37], set smart disclosure standards in specific fields, suggesting that "government inspired" and "industry led" projects, such as Green Button in the U.S., might contribute to fill this gap.

6. – Conclusions and future research

Public data reuses by businesses are sometimes serendipic. However, by disclosing specific datasets, governments can expect that explicit policy objectives are met. Setting a standard for consumption data disclosure, and make it adopted by a broad range of utilities, naturally calls for new services. And having the chance to use actual consumption data, instead of assumptions, makes a difference. What has been suggested is that making available complementary data flows is supposed to maximise the impact of data reuse. Thus, when setting sector-specific agendas grounded on data disclosure, public agencies should consider (contributing) to make available several layers of information. In the case of energy, not only average costs, but also actual offers by utilities are extremely useful to perform meaningful comparisions for users, improving market transparency and reducing switching costs. As far as the EU is concerned, no widely acknowledged iniatives of energy consumption data disclosure to users are being implemented in the EU. Moreover, browsing EU data portals and websites of public agencies, we find that other key data ingredients are not supplied (or, at least, not as open data), leaving room for possibile improvements in this arena.

Further interdisciplinary research questions may call arise. We mention a few of them.

Which are the actual incentives / business models for utilities to open up consumption data? In this paper, some are mentioned. However, a broader assessment – e.g, using econometric tools – could be undertaken, considering both companies structural features (e.g., capital structure), and more volatile ones (market share, short-terms objectives, to mention a few).

Secondly, one could ask herself which kind of architectural models – e.g., centralised vs decentralised – are the most suitable for sharing consumption data to users. This aspect is particularly relevant in the EU. The Netherlands, for example, has found the usage of smart meters to be contrary, to some extent, to the European Convention on Human Rights (e.g., in the case of central data-collection initiatives) [39].

Acknowledgement

This paper was drafted in the context of the Network of Excellence on Internet Science EINS (GA n°288021). The author acknowledges the support of the European Commission. Also, the author wishes to thank Jeff Ammons (Simple Energy), Deep Chakraborty (enACT), Ben Hood (WattBuddy), David Kirkby (wotz), Alison Mickey (Clear Power Finance), and Mithun Mohan Nagabhairava (Innovative Solar Demand Response) for their useful insights.

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SMARTPA: REAL TIME ANALYSIS AND MONITORING OF ITALIAN PUBLIC ADMINISTRATION WEBSITES

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In 2013, the Institute of Informatics and Telematics of the National Research Council (IIT-CNR) and the Department for Digitalization and Technological Innovation of the Presidency of Council of Ministers, carried out a pilot project, whose main aim was to create a monitoring system in order to verify and analyse the capacity of Italian Public Administrations to activate and manage information and services by means of the Internet. This paper describes the SmartPA (System for the Real Time Monitoring and Analysis of the Italian Public Administrations) application, developed by IIT-CNR, which analyses and monitors Italian PAs, evaluating in real time conformity and coherence of contents with Guidelines regarding PA websites, issued in the years 2010 and 2013. SmartPA, through the publication and presentation of results on a public portal, aims to establish an open and transparent communication between the citizen and Public Administration, thus bringing about a process of continuous quality improvement of PA websites.

1. – Introduction

Within the 2012 e-Government plan and in the context of modernization of Public Administration, the 2009/11/26 Directive of the Ministry for the Public Administration and Innovation [1] [2], in order to rationalize Public Administration (PA) websites and to improve the quality of services and on-line information for the citizen, set out specific Guidelines. These are designed to provide clear indications regarding general criteria and operating tools for the rationalization of online content, for the reduction of obsolete public websites and improvement of active sites [3].

Within this context, and in the framework of a collaboration between the Department for Digitalization and Technological Innovation (DDTI) of the Presidency of Council of Ministers, DigitPA and the Institute of Informatics and Telematics of the National Research Council (IIT-CNR) ([4]), a pilot project with the purpose of setting up a monitoring system for the evaluation of the quality of PA websites was launched in 2010 [5]. The system, named SmartPA - System for the Real Time Monitoring and Analysis of the Italian Public Administration websites, starting from .it domain names registered by Italian PAs , enables verification and analysis of the capacity to activate/manage information and services by means of the Internet and web channels. This evaluation has been carried out through the study and definition of an indicator of PA websites, measured in terms of coherence or compliance with regards to a minimum set of compulsory prerequisite contents, indicated in the Guidelines.

2. - The PA guidelines

The Guidelines, which are an essential feature of the initiatives aimed at innovating the PAs, were issued in the years 2010 and 2013 by the Italian Ministry of Public Administration and Innovation.

They have the objective of establishing an open and transparent communication with the citizen, so bringing about a process of continuous quality improvement of public websites.

In particular, the Guidelines pay special attention to the definition of a map of 69 minimum essential requisites that must be satisfied within institutional PA websites on the basis of current legislation (e.g. Digital Administration Code, Italian Data Protection Authority, etc.).

Each PA must have one (and only one) institutional website. According to the Legislative Decree ([1],[2]) each institutional website must contain a certain number of specific sections , each one identified by well-defined names. Within these sections, with specific keywords, some sub-sections are foreseen. PA institutional websites must include, for example, the sections: organizational chart, external relations office (URP), transparency of information, evaluation and quality of personnel, administrative procedures, notice of public tenders, job competitions, on-line services, legal notices and electronic mail certificate (PEC), etc.

Each guideline has been associated with keywords defined in an ad hoc dictionary. The dictionary is in JSON format and, for each guideline, it specifies a set of keywords that must be searched and the related pages (sections) where these keywords should be found. Rules in the dictionary can be based on exact match or through the use of regular expressions.

A PA website is considered "compliant" with a guideline if it satisfies all the requisites specified for that particular guideline. For example, a subset of information related to the PA's "transparency" is identified by the second level sub-section "Programma per la Trasparenza e l'Integrità". This means that for the institutional website to be compliant with that specific guideline, the "transparency" information must be precisely referred to through a section named in this way. However, this is clearly too restrictive, due to the definition in the Legislative Decree of very long labels for some sections, or to the use of special characters. In order to overcome this difficulty and to avoid classifying a website as non-compliant where the information is present but it is labelled with keywords similar or synonymous of the ones specified in the Guidelines, we introduced, in the dictionary, the use of regular expressions (that allowed us to find close variants of the specific keywords chosen) and the concept of "partially compliant". Websites satisfying these criteria are classified as partially compliant with the guidelines. Clearly, websites not satisfying the dictionary rules are classified as "not compliant".

3. - Architecture

The SmartPA architecture is of a modular type (Figure 1). The system is subdivided into two macro-components, the *engine* and the *portal*. The engine is the elaborating part of the system, whereas the portal is the interface that enables the management of the engine and consultation of the results elaborated.

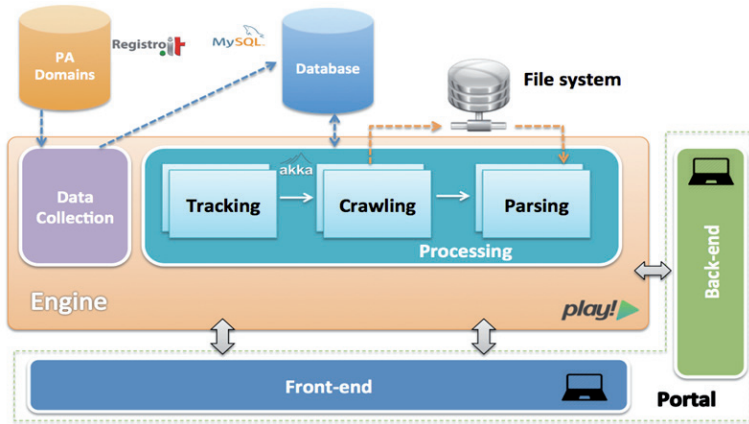

Figure 1 - SmartPA architecture

The *engine* module, which uses the Akka framework [6] for the creation of concurrent elaborations [7][8], implements all the SmartPA logic, collecting, elaborating and retrieving data. The website analysis was made by means of the parsing library Beautiful Soup [9].

The *portal* module, created by means of the Play Framework [10] web application, thanks to the use of the most advanced web technologies (HTML5, CSS3, JavaScript, etc.), is compatible with main Internet browsers and mobile devices.

All the results (metadata, partial and total elaborations regarding analysed subjects, references to downloaded web pages, etc.) are stored in a dedicated database. The html pages, which make up the monitored website, are stored in a file system, so as to enable future research and comparison.

4. - The Engine component

The SmartPA engine is subdivided into three main stages (Figure 2):

- *Data Collection* – this identifies the data set of relevant domain names (domain list) on the basis of which the analysis and monitoring of domain names is initiated;
- *Data Processing* – this uses the data of the Data Collection stage and is the key stage of the system. In fact, during this stage all the main activities and elaborations that make up the website analysis and monitoring process are carried out;
- *Data Discovery* – this is based on the Data Processing stage and identifies and associates a Public Administration with its specific institutional website.

The activity of Data Collection is mainly carried out during the initial stage of database population and in order to add new subjects to the monitoring process. On the other hand, Data Processing and Data Discovery activities can be initiated upon request of the user (real time) or periodically by the system (pre-established time intervals).

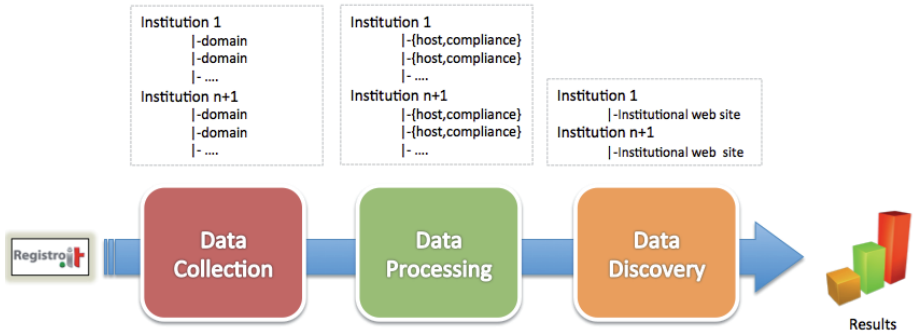

Figure 2 - SmartPA engine

4.1. - The Data Collection stage

Domain names, by their very nature, can be assigned to different types of registrants (public bodies, natural persons, companies, etc.). These are identifiable in the .it Registry by means of a specific univocal code, which identifies the entity type of the subject. Using this code it was possible to retrieve the domain names assigned to Italian Public Administrations ([11]), to identify the institution they belong to, and for each registrant, identify the category (local institutions, research institutes, schools, companies, local health authorities, etc.).

This activity also involved a preliminary process of data clean up to prepare the SmartPA database data to work correctly. In fact, in order to avoid potential errors occurred during the registration of .it domain names, a manual phase was carried out by operators and ad hoc scripts were developed to crosscheck data registered in the .it Registry database with the ones retrieved from external sources (Italian Agency of Revenue, Italian Chamber of Commerce, etc.).

4.2. - The Data Processing stage

On the basis of the data set of domain names obtained in the Data Collection stage, the websites of each public administration were analysed and conformity with the Guidelines were assessed. This phase involved a set of elaborations carried out by three ad hoc modules: the *tracker*, the *crawler* and the *parser* modules.

The *tracker* module identifies the URL of the homepage of the website associated with the domain and is able to filter replications of websites hosted by different domains, but belonging to the same PA. Particular attention was paid to the study of false positives such as white pages, splash screens, and sites under construction, etc.

The *crawler* module, based on HTTrack library [12], uses as input the URL of the homepage obtained by the tracker and downloads the associated website. Given that, the minimum contents foreseen by the Guidelines can be found also in second level subsections, for each website a download of at least three levels was carried out.

The *parser* module, based on the Beautiful Soup library and lxml ([13]) as parsing engine, has the task of verifying the presence and compliancy of the contents foreseen by the Guidelines.

The use of Beautiful Soup library makes the parsing of HTML documents with malformed mark-up (i.e., non-closed tags) also possible.

For each content item the parser gives three different results (compliant, partially compliant, not compliant), and provides a final score for each website.

4.2.1. - How the Parser works

For each guideline, the compliance analysis is performed through three phases as shown in Figure 3:

1. Sections search, i.e., pages linking the content;
2. Keywords search within the sections;
3. In case of failure, a global search is executed on the whole website.

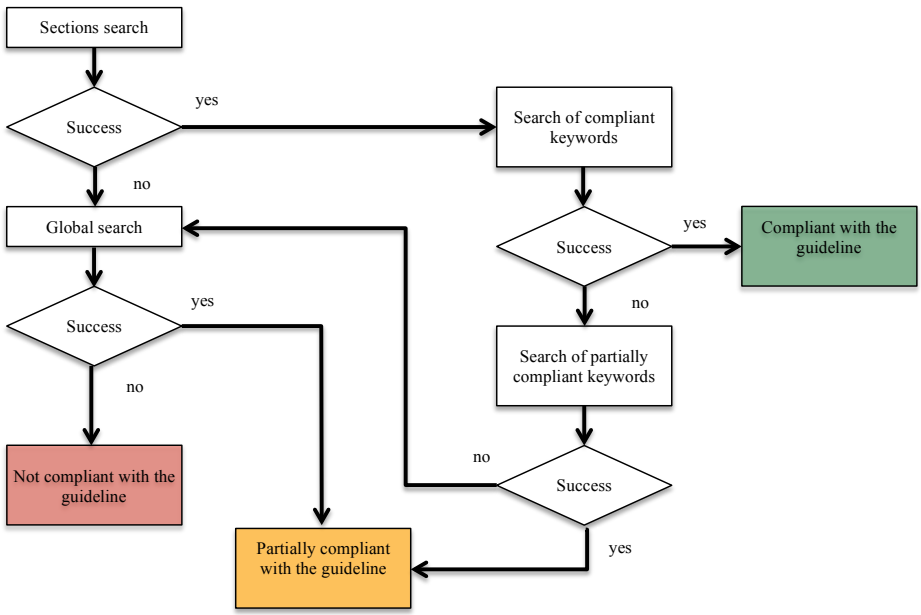

Figure 3– Parser flow

For each identified section, a keywords search is performed on all the extracted anchors (tag <a>) inside:

- the content (<a>keyword);
- the attributes *a* and *title* (… or … <a>).

If the anchor contains nested tags, they will be recursively analysed. For instance, a common case is provided by the image usage: <img alt="URP">.

Each PA can have multiple websites, but only one of these should correspond to the so-called Institutional website, the one that identifies the PA institutionally and highlights the structure, organization, staff, salaries, services offered, etc.

The purpose of the system, at this stage, is to identify the most likely institutional website of each PA. This relies on a scoring system (ranking) that takes into account, as weighted average, the results obtained by the parser (number of compliance with the Guidelines), the domain name pattern and the website URL pattern (Table 1).

Rank	URL	Compliance	Reason
1	http://www.comune.pisa.it	66/69	Institutional website (identified)
2	http://comune.pisa.it	66/69	Missing "www"
3	http://www.comune.pi.it	66/69	Not the best pattern - "pi" less clear than "pisa"
4	http://cittapisa.it	3/69	Clearly not institutional for the numbers of compliances

Table 1 - Example of identification of the institutional website according to the scoring system

Table shows that *http://www.comune.pisa.it* has been ranked 1 among the examined URLs and the system has identified it as an institutional web site. The others URLs were downgraded due to domain name reasons, or lack of requirements (e.g., numbers of compliances, evidence of not institutionalism, etc.).

5. - Portal

The Portal consists of two modules and two separate sections, the public section dedicated to the presentation of data and statistical results (Front-end) and the system administration section (Back-end). The portal was designed to be intuitive, easily usable for the general public, accessible and equipped with a clear response layout for mobile devices (Figure 4).

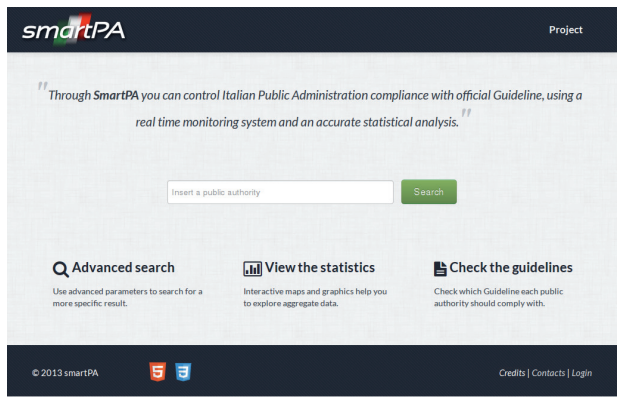

Figure 4 - Homepage of the SmartPA portal

results made available (as an anonymous visitor without credentials or as a user registered in the portal), or for its management (as administrator, operator and maintainer).

5.1. - Front-end

The *front-end* module implements the portal section dedicated to the display of results. Among its main features this section includes the search (exact and partial) of a PA, and visualization by means of reports, charts and graphs of its descriptive information and compliance of the institutional website with the Guidelines (Figure 5).

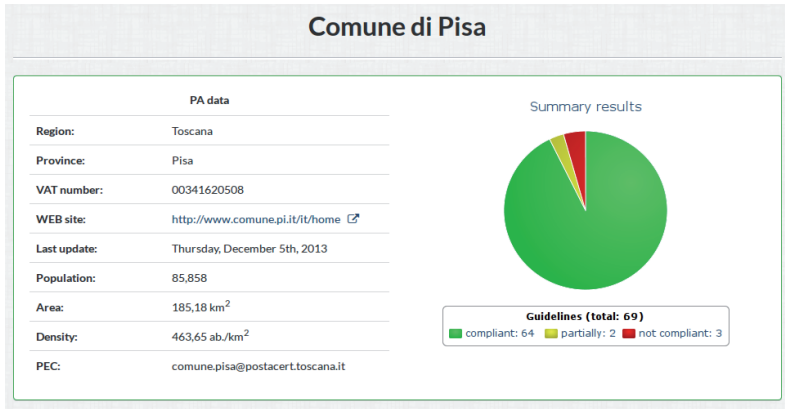

Figure 5 - Example of a search result

This section also enables the user to search and, consequently display statistical aggregate data according to selectable parameters, such as the territory (on a national, regional and provincial basis), the type of PA or a specific Guideline (Figure 6).

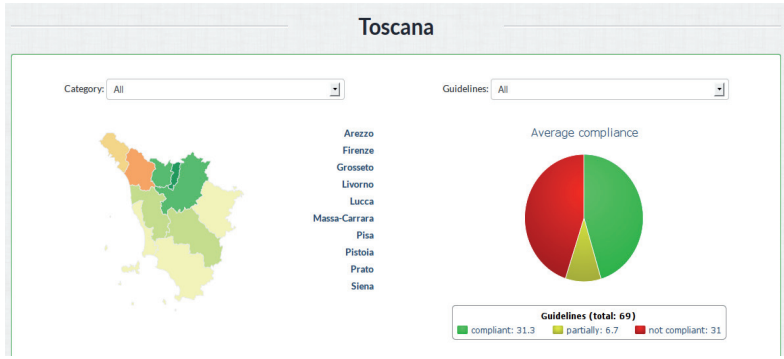

Figure 6 - Results at a regional level

5.2. - Back-end

The *back-end* module implements the section of the portal dedicated to system administration and interaction with the procedures of data collection. This section offers an extensive set of features that enable the user to manage and monitor the main features of the system (information processing, domain names, organizations, users, system logs, general settings, etc.).

Through the back-end, it is possible, for example, to launch Data Processing (see par. 4.2) and Data Discovery (see par. 4.3) processes and visualize the elaborations in real time, thanks to dedicated visual media. In the case of multiple instances of same time elaborations, they are managed by means of an ad hoc queue.

Other important features that are implemented in the back-end module are: visualization of the archive of the operations performed, consultation of the systems log, modifications of the profiles of the subjects undergoing verification (personal details, domain names associated with them, Institutional website URL, etc.) and management of the system users (Figure 7).

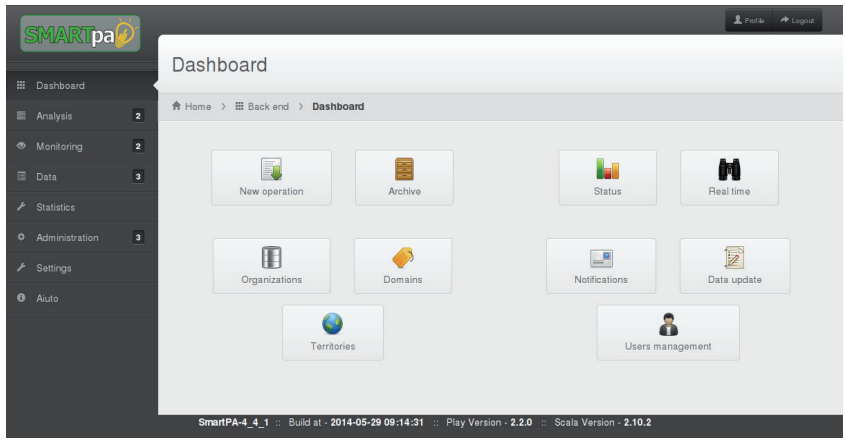

Figure 7- Back-end Dashboard

6. - Main results

An accurate test phase was performed on the system. Random manual checks were carried out in order to improve the quality of the dictionary.

The adoption of the latest Guidelines ([2]) allowed us to obtain results that are more precise. In fact, the new Guidelines accurately define the keywords and the position they must have within the sections, reducing in this way the introduction of false positives and false negative results.

The main statistical results obtained after the entry into operation of the analysis and monitoring system of the websites of the Italian PAs are indicated below.

In January 2014 around 2,635,000 .it domain names were registered, 34,115 (1.29%) of which were assigned to Italian Public Administrations. 45% of these domain names (15,541) are associated with subjects belonging to categories of interest of the present study (Councils, Provinces, Regions and Ministries).

Among these subjects, over 8,232 PAs, only 314 did not have an .it domain. Some sample surveys showed that the main reasons for this are, for example, the availability of a domain name other than .it (.com, .eu, .net, .org), or the absence of a website for the institution, etc.

Of the 7,918 PAs with an .it domain, 809 did not have a valid website[2] and were therefore not analysed.

The other results shown here include in the count of compliance with the Guidelines the sum of the "compliant" and "partially compliant" results. The percentage values shown take into account the mean of the percentage values of conformity of each single institution calculated on the basis of the 69 guidelines.

Taking into consideration the analysis of the compliance of PA websites with the Guidelines, the results show that on average, the degree of compliance is 47.7%. Therefore, around 33 Guidelines out of 69 are fully or partially respected in the websites of the PAs analysed.

The highest average compliance at the regional level is achieved by the PAs of the Sardinia (70.7%) region. On the other hand, the lowest average compliance can be found in Trentino Alto-Adige, with only 6.4% of compliant or partially compliant websites (Figure 8).

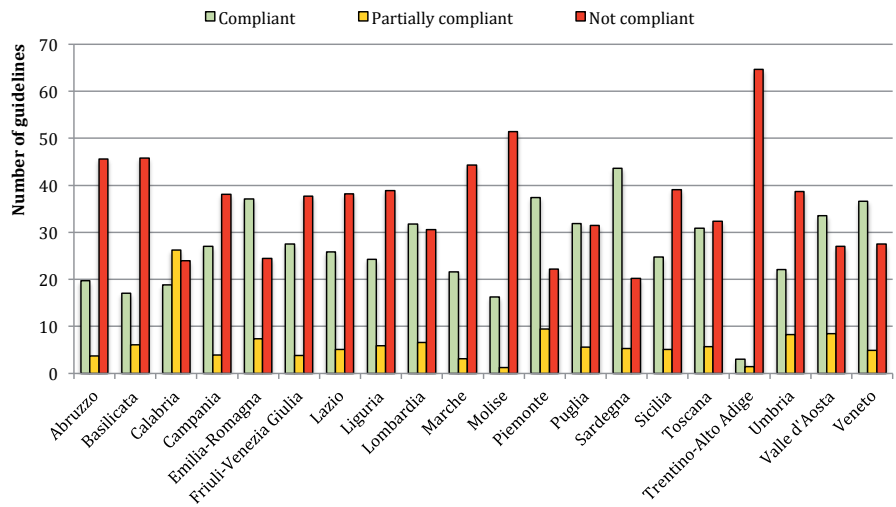

Figure 8 – Compliance with Guidelines per region

Figure 9 shows the conformity distribution for each Guideline. The graph does not identify particular differences between the Guidelines, which, on average, have quite uniform trends.

[2] In this context, a website is defined as "*not valid*" when the PA does not have an institutional website

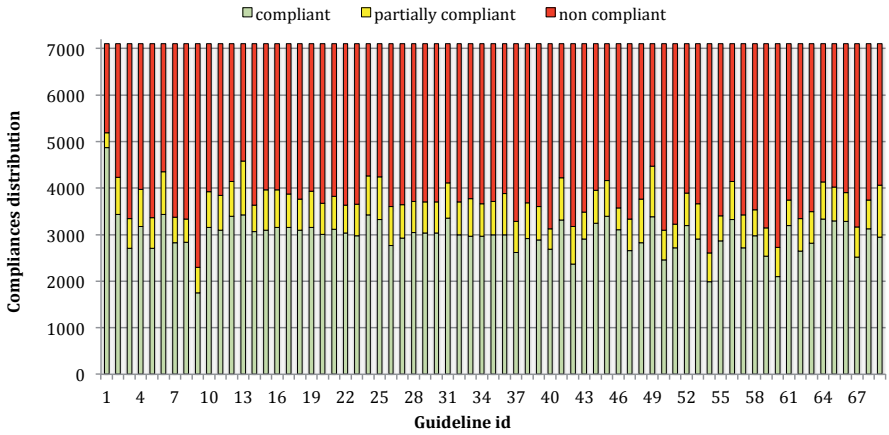

Figure 9 - Compliance distribution per Guideline

At a national level (Figure 10), results show that:

- 154 PAs have 100% compliant website with the Guidelines (including 90 PAs that have a website partially compliant with the Guidelines);
- 1248 PAs have the institutional website that does not comply with any Guideline.

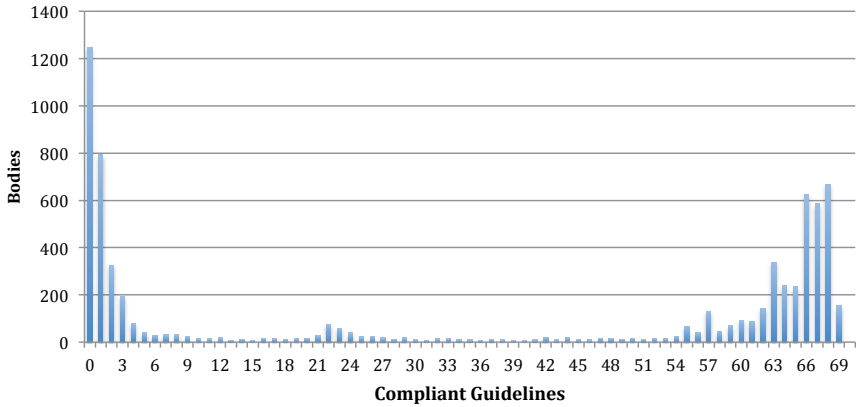

Figure 10 - Number of Bodies for Compliant Guidelines

Taking into account the situation at a Macro Area level (North, Centre and South), we can see that (Figure 11):

- PAs of the North have a degree of compliance with the Guidelines of 50.56% (35 guidelines out of 69 are respected);

- PAs of the Centre have a degree of compliance of 44.35% (31 out of 69 Guidelines are respected);
- PAs from the South and the Islands have a degree of compliance with the Guidelines of 48.19% (33 out of 69 Guidelines are respected).

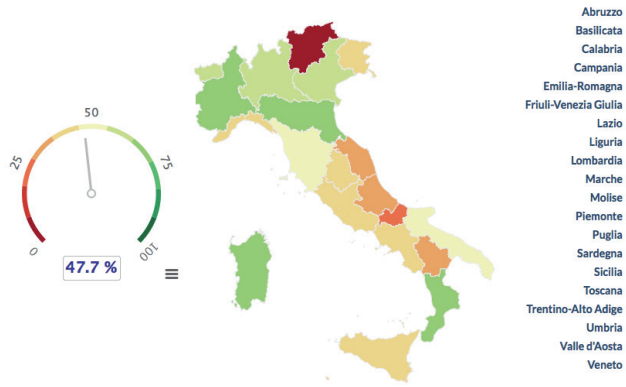

Figure 11 - Compliance at national and regional level

7. - Conclusions and future developments

The aim of SmartPA is to suggest criteria and tools for the rationalization of online contents, the reduction of obsolete public websites and the improvement of active sites.

Results show that in Italy there are still many Public Administrations that do not fulfil the requirements specified in the Legislative Decree.

This study also highlights the difficulties that a citizen may encounter while accessing a PA website, given that multiple domain names are often associated with it. In order to solve this problem it is suggested that a digital mark is used. This should indicate the institutionalism of the reference website of the public body.

At a geographical level, there are no major differences as far as the quality of results is concerned. Only for Trentino Alto-Adige do results differ from the national average; a possible explanation could be the presence of contents written in another language (German), given the bilingual nature of this region.

SmartPA is easily adaptable to other international e-Government contexts. Due to its modularity, it allows the creation of custom rules in order to evaluate the quality of Public Administration websites.

Currently the SmartPA portal is not yet publicly available due to the lack of an official agreement with the Presidency of Council of Ministers.

In order to contribute to the improvement of PA websites, SmartPA is constantly evolving. A set of tools and advanced features are foreseen in order to increase awareness and, at the same time facilitate PAs during the phase of adjustment to this Decree.

These features include:

- extension of the analysis and monitoring to all Italian PAs;
- for each guideline, semantic analysis of the sections information in order to verify if the related content is appropriate or not for the section itself;
- a user-reserved dashboard, enabling the PAs to manage their own profile and independently analyse the "quality" of their institutional website;
- a tool for validating the accessibility of Institutional PA websites, able to verify adherence and compliance with the Guidelines for web content accessibility foreseen by the Stanca Act [14];
- the historical record of PA websites, able to show the trend over time of the quality of websites and services;
- information and results in Open Data format [15];
- availability on the front-end of tools for the creation of rankings, comparisons between two or more PAs, and possible links between institutions;
- creation of a quality stamp to be assigned to the PAs with high levels of adherence and compliance with the Guidelines;
- identification and notification of obsolete websites;
- development of an "app" for mobile devices.

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SOCIAL NETWORKS AS TOOL FOR E-GOVERNMENT – CASE STUDY OF REPUBLIC OF SRPSKA GOVERNMENT

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Provision of timely and accurate information to citizens and obtaining feedback information from them are crucial for G2C and C2G communication model. Republic of Srpska's (RS) organs and institutions mostly use traditional forms of communication – letters, telephone and fax. Social networks today are presenting cheapest and most affordable form of communication that is efficient and effective for massive number of users. The trend in governments around the world shows increased use of social networks for communication with citizens. This paper intended to analyse presence of RS's public administration at social networks and to point on trends in this phenomenon. During observed period, research results have shown that the potential of social networks in case of RS's public administration is poorly utilized

1. – Introduction

In today's expansion of information and communication technologies (ICT) and Internet, the traditional work of public administration is failing to provide adequate results and to be transparent, efficient and effective. Citizens empowered with modern ICT are constantly increasing demand for various governmental services. Introduction of electronic government and governance facilitates efficient interaction and communication between the government and its main stakeholders (citizens, business, other governments and their institutions, as well as whole non-governmental sector). E-government is seen as effective tool to reduce corrupt behaviour, promoting transparency and good governance by enhanced relationships with citizens and by more effective monitoring of civil servants behaviour [1].

Broad availability of social media has increased the expectations of citizens in terms of responsiveness when accessing all kinds of services on line. The combination of new technologies, open specifications, innovative architectures and the availability of public sector information can deliver greater value to citizens with fewer resources [2].

Social media today are presenting cheapest and most affordable communication channel, highly efficient and effective, especially dealing with large number of users. The organs and institutions of public administration tend to use various social networks for improvement of communication channel with its stakeholders. The recent study on use of social media by public administration shows that there are strong differences between the respective popularity of social media services by governments and concludes that the most-used social media platforms are Twitter, YouTube and Facebook [3]. This conclusion is in line with the research performed by team of Spanish researchers on use of WEB2.0 technologies and social networks by local governments in European Union (EU) [4]. The team concluded that majority of examined 75 local governments in EU are using Twitter - 32% of governments have official Twitter profile, while the least popular is LinkedIn considering the nature and purpose of this social network for professional networking. Surprisingly, Facebook profiles have

registered only 17% local governments, while YouTube channel have 29% of examined local governments.

Another study, but this time with non-governmental sector, concluded that 85% of US based NGOs tested also use Facebook and Twitter [5]. Necessity for more dialogically engaged community is possible to achieve if organisations are pro-active in use of social media thus increasing overall transparency of work [6]. This will imply that pro-active use of social medial in public administration should produce same effect.

Social media are considered as a powerful tool for government to establish and maintain one- and two-ways communication with its stakeholders. One of main advantages of social media is that they enable transition from "talking at audience" to "talk with audience", or with other words, interactions that are omnidirectional – from one-directional telling to multidirectional interacting [7] [8].

The combination of e-government, social media, Web-enabled technologies, mobile technologies, transparency policy initiatives, and citizen desire for open and transparent government are encouraging a new age of opportunity with potential to create open, transparent, efficient, effective and user-centric e-services [9].

Moreover, it is still on-going debate on should governmental e-services be supported by social media? In line with this, a group of authors (Broughton, Higgins, Hicks and Cox, 2010.) discussed the policy and practice relating to the use of social media by employees in British Telecom and Her Majesty's Revenue and Customs [10]. This, more behavioural issue, was not investigated in this paper since it requires different approach but will be treated in some future works.

Public administration in Republic of Srpska (RS) still uses traditional communication channels with citizens and business – postal mails, telephone and fax as major tool for communication. The aim of this research was to determine how many institutions are using these modern tools and technologies for operations, and do they use it at all? The assumption is that these tools are underused and those institutions of public administration that use them are not doing it efficiently.

2. – Methods and materials

The research was carried out combining desk-research and a review of web sites of institutions in question and determined social media. The first involved the consultation of national government policy and strategy documents, as well as existing international studies on the issues of interest. Most of literature consulted was found on Internet as main medium for electronic communication and future business.

This research method was used to review domestic and foreign literature, but it should be noted that the volume of domestic literature in this area is quite small and limited to a theoretical interpretations of general knowledge about e-business and e-government. Very few research papers that approach the problem of e-governance in Public Administration of the Republic of Srpska and even less papers in reviewing of effects of social media as tools for provision of e-services by public administration. The first phase of research, where this was the most used method, is extensively done in the period from June to August 2013. Review of domestic legislation shows very slow implementation of reform in public administration in Bosnia and Herzegovina, both on entity and state level.

Second phase of research was conducted in period until December 2013 including data processing and formulation of conclusions. The data on presence of public administration on social media were collected by reviewing four previous mentioned most important social media: Facebook, Twitter, LinkedIn and YouTube. In order to perform this review it was necessary to investigate number of public administration organs and institutions of interest, as well as their electronic addresses and web presentations.

To make analysis and draw conclusions, it was necessary to determine metric indicators that are presented in Table 1. In order to obtain more complete picture on effects of social media in public administration, it is necessary to approach each organ and institution individually and to review their statistics as account owners. Only access as account owners will provide full insight in communication effects, since the account owner can access analytical tool provided by social media itself.

Third phase of research was performed during period 17-28.5.2014. This phase was used in order to observe trends and change of indicators due to mass flooding that hit Bosnia and Herzegovina, Serbia and Croatia. The results of research will show that emergency situations increase interest in use of social networks on both sides – on side of government for publishing of timely and accurate information, and for citizens in order to reach accurate information on actual situation and to connect with their relatives.

Social network	Indicator	Definition of indicator
Facebook (FB) (www.facebook.com)	*Friends*	Friends in FB are legal or natural persons that are in any relation with the owner of FB profile: family members, friends, colleagues, co-workers …
Twitter (TW) (www.twitter.com)	*Followers*	Follower is natural or legal person that is interested in posts submitted by owner of the account.
LinkedIn (LI) (www.linkedin.com)	*Contacts*	Contact is a person that has some of relations with owner of the profile: colleague, classmate, friend, "done business together" or "other". Contact is usually natural person, but legal persons also can have LI profile.
Youtube (YT) (www.youtube.com)	*Subscribers*	Subscriber is a person that added itself (subscribe) to the channel. Subscriber can be legal or natural person.

Table 1: Social network metric indicators (authors original)

3. – Results and discussion

In order to understood properly use of social media in RS public administration, it is necessary to understand overall implementation of ICT in RS as entity in Bosnia and Herzegovina (BiH), as well as the state-of-art in implementation of public administration reform in BiH. As part of desk-research performed, authors analysed two main important indicators:

1) overview of BiH's Networked Readiness Index (NRI) that provides overall insight in implementation of ICT in BiH, and
2) overview of implementation of Revised Action Plan 1 of the Strategy of the Public Administration Reform in BiH that provides insight in real changes in implementation of e-government at all three levels of governance in BiH (state, entity and district).

NRI presents conceptual framework for evaluation of ICT impact on global level. It combines ICT (tools, services and models) with importance of competitveness, progress and development in economy. This index is very important since it identifies areas where is necessary to make political interventions (investments, regulations, incentives and other measures). NRI is developed by World Economic Forum and is published annually and is composed of three components: the environment for ICT offered by a given country or community (market, political, regulatory, and infrastructure environment), the readiness of the country's key stakeholders (individuals, businesses, and governments) to use ICT, and the usage of ICT among these stakeholders [11].

In summary terms, the total value of NRI for BiH in 2013 amounted to 3.80 ranking BiH at position 78 of the 144 observed states. It is necessary to point out the fact that this index classifies BiH in the middle group of countries in the development and use of ICT. Compare to the countries in the region, the former Yugoslav republics, only Serbia is behind BiH. According to the importance of ICT to government vision, BiH is placed as 113 with the index value of 3.3. An Index on-line government service (on a scale of 0 to 1) is 0.37 that puts BiH on the 95 place. In terms of government success in ICT promotion, BiH is placed as 85 with the index value of 4.1. However, e-participation index (on a scale of 0 to 1) was 0.00 which placed BiH at the 124 position.

The pillar "Government usage" is identified and defined by three indicators (variables) that provide insight into the importance the Government attaches to the implementation of ICT policies for competitiveness and improving the welfare of citizens, efforts to make the implementation of the vision of ICT development, as well as the number of on-line services that the government provides.

The total value of NRI for BiH in 2013 amounted to 3.80 as BiH ranks at position 78 of the 144 observed states. According to newest data for 2014 the situation is a little bit favourable for BiH in total. This year's total value of NRI for BiH shows moderate increase amounted to 3.99 ranking BiH at position 68 of the 148 observed states.

However, the indicators for usage of ICT are in decrease compare to previous years, except for individual usage. Based on the results from this year's report (2014), among the 148 analysed countries, BiH is located at:

- 61 place regarding individual use of ICT (individual usage)
- 126 place on the use of ICT by businesses (business usage), and
- 123 place on the use of ICT by governments (governmental usage).

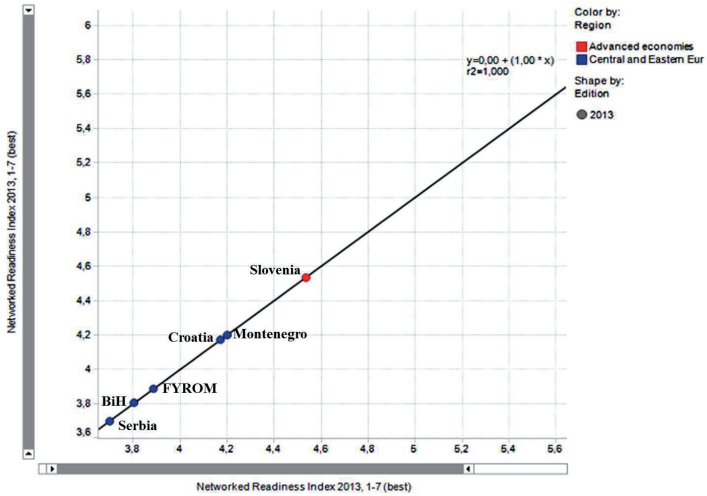

Figure 3 : Position of BiH compare to other neighbouring countries in 2013 (source: Global Information Technology Report 2013, World Economic Forum)

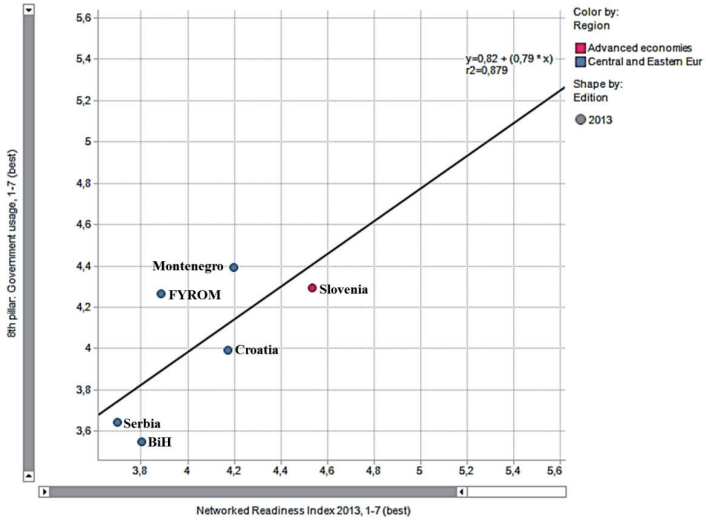

Figure 2 : Pillar: Government usage – position of BiH compare to other neighbouring countries (source: Global Information Technology Report 2013, World Economic Forum)

These data suggest that, in fact, most of the ICT is used by individuals - citizens in their daily lives for a variety of purposes, as well as insufficient use of ICT for business, or public administration. The conclusion arising from this is that the citizens of BiH are ready to use on-line services of the public administration (e-services). Putting it in the context with other surrounding countries (Figure 2), it shows that BiH is at the back related to the use of ICT in the work of public administration and related to the number of available e-services. Comparing to previous years, it is possible to observe constant increase in individual use opposite to constant decrease in business and governmental use. There are numerous of reasons that can explain this situation. However, the aim of this work was not to analyse these factors and reasons, but it can be a subject of some future work.

NRI provides overall picture and position of BiH in implementation of ICT. However, another important factor is implementation of on-going initiatives on reform of public administration in BiH. This reform of public administration in BiH should improve overall rating of BiH NRI upon implementation.

The Strategy for Public Administration Reform (PAR) will focus efforts in working together to: create a public administration that is more effective, efficient, and accountable for what it does; that will serve the citizens better for less money; and that will operate with transparent and open procedures, while meeting all conditions set by European Integration, and thereby truly become a facilitator for continuous and sustainable social and economic development [12].

Although the Strategy was divided in three phases (starting in 2007), the results of implementation are still moderate despite the fact that end of strategy implementation was projected for this year. From the analysis and biannual report on implementation in 2013 [13], it is obvious that reform process in on half-way (Figure 3). According to the report on implementation, the most of reform was done in the area of "Institutional communication" –(67,44%), while the least was done in the area of "Information technologies" (45,25%). The last one is very important for establishment of efficient work of public administration from the implementation point of view since this is related to use of ICT and its tools.

	TOTAL	BiH	FBiH	RS	BD BiH
Planned by the end of 2014	100%	100%	100%	100%	100%
Planned by mid-2013	66%	66%	67%	66%	66%
Implemented by mid-2013	40%	39%	35%	47%	37%

Table 2. Overall implementation of objectives from the Revised Action Plan 1 (source: Biannual Progress Report, Public Administration Reform Coordinator's Office, Council of Ministers of BiH, 2013)[1]

These first two analyses proved that there are capacities by Government and interest by citizens for e-services and use of ICT for communication. Since these two were positive, next it was necessary to discover visibility of public administration in social media. In this light, the analysis with aim to determine the presence of Republic level institutions in social media was implemented in period July – August 2013. The research sample covered 84 institutions that met Agency for Information Society in RS (AIDRS) criterions for analysis on-line presence of Republic institutions [14] and these institutions were categorized as shown at Figure 4.

[1] Acronyms: BiH – Bosnia and Herzegovina (state level), FBiH – Federation of Bosnia and Herzegovina (entity level), RS – Republic of Srpska (entity level) and BD BiH – Brčko District (district level)

The analysis approved assumption that the potential of social networks in case of RS's public administration is poorly utilized. Vast majority of analysed institutions (84%) is not using social media, while only 14 institutions (16%) it does. Table 3 shows representation of selected social media by Republic institutions. Authors did not examine reasons for poor utilization of such free-of-charge tools for communication. The fact is that RS government does not have policy for use of social media in its institutions and employees are not aware of its potential for everyday operations. Also, most of employees are fear of using it in business purposes due to possible misuse. But these are just assumptions and this could be topic for another research in future.

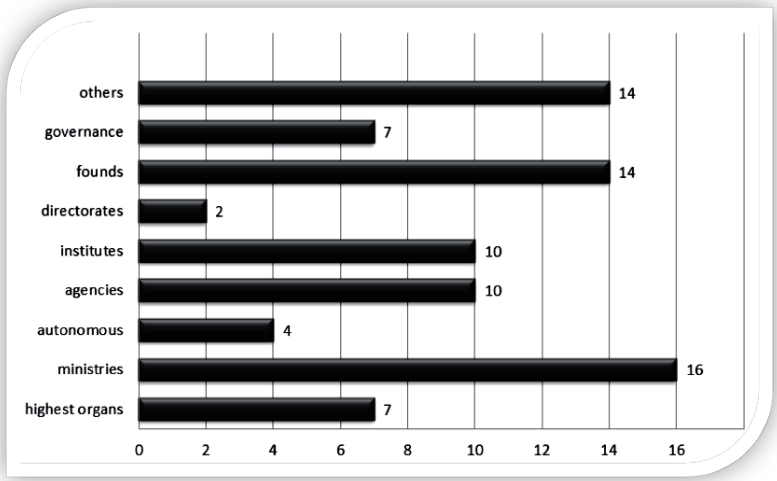

Figure 4 : Number of analysed web sites per institutional category (authors orig.)

In line with papers cited in the introduction of this work, the most frequently used social network is Facebook with 8 institutions using it (see Table 3). Second position share Twitter and YouTube with 4 institutions per each social network, while least used among selected networks is LinkedIn with only 2 institutions that are using it.

As expected, LinkedIn due to its nature is least popular among public administration. The fact is that LinkedIn should be more used by civil servants in order to be familiar with news in their respective domain of work by participating in LinkedIn groups. There are numerous groups dealing with issues related to government activities. From the analysis is obvious that public administration in RS is not using LinkedIn, except Republic of Srpska Investment-Development Bank (IRBRS) and Environmental Protection and Energy Efficiency Fund of the Republic of Srpska (EPF). There are several reasons why is this happening but main one is the nature of this social network – professional linking. IRBRS recognized this social network as possibility and place for promotion of its activities and linking with potential partners. At the end of 2013 IRBRS had 61 and today it counts 106 followers. This means that in some six months period IRBRS increased number of connections for almost 50%. EPF is showing similar trend. In December 2013 analysis, they counted 37, while today that number is 51 followers. This just shows the power of professional social network, as place where business can find interest, not only in linking but also in following of actual trends and movements.

	Ministries	Agencies	Institutes	Foundations	Inspections	Autonomous	Other
FB	2	3	0	1	0	0	2
TW	0	1	0	0	0	0	3
LI	0	0	0	2	0	0	0
YT	1	1	0	0	0	1	1

Table 3: Use of selected social media per category of institution (authors orig.)

Although Facebook is most represented social network among Republic institutions, the use of it is very limited. Namely, from the analysis of posts it is obvious that posts are not regular but more occasional and linked to major events happening in country. This can refer to the fact that public administration is missing strategic policy documents, such as policy on use of social media in public administration. Also, this task is not defined in structure of institutions and is done usually by public relation officer of given institution.

Facebook account of Ministry of Internal Affairs of RS was created in 2012 and since then it managed to attract 4551 friends. During the flooding during May 2014, this account was very busy posting vital and important information on missing and found persons, distribution of humanitarian aid, status of rescuing etc.

Another ministry using Facebook actively is Ministry of Family, Youth and Sport with 1155 friends since 2012. Ministry was using this profile intensively in last week in order to attract young people helping flooded areas with collection and distribution of humanitarian aid on voluntarily basis.

Although created to be facilitating agency for introduction of information society in RS, the success of AIDRS is not visible and promising. Opposite to expected, on their Facebook profile there are only 289 friends and the post are occasional and not frequent 2-4 per month in average.

An interesting fact is that Official Gazette of Republic of Srpska (Službeni glasnik RS) registered Facebook profile in October 2012 and today counts more than 1700 friends. They are regularly posting information on issued publications, as well as on other related publications. In period for subscription, they publish open invitation for subscription. Each time new issue of Official Gazette is published, the post being published with link to it. However, it requires a prior authorization to view content. Only subscribed users can view the contents.

Government of Republic of Srpska is having official Twitter account registered with more than 2900 followers and more than 1600 tweets (date of collection 28.5.2014.) The profile is having regular update with most important information from Government of RS. It is possible to find also official hymn of RS as video file. First tweet was posted in 2011 and all relevant information have link to governmental site with more details on topic. Some of citizens tried to post questions, but the answer was to look for direct contact in relevant ministries.

Ministry of Internal Affairs is having YouTube channel since year 2012, where it is posting video clips of actions that this Ministry is undertaking for preservation of order and peace. On 28.5.2014 YouTube channel of this Ministry counted 14 video clips and 488 subscribers with more than 250 000 views. Although the number of subscribers is insignificant, it is interesting number of views. Using simple calculation (250000/488) it seems that one subscriber has seen one post for more than 512 times. This ratio can be explained with one phenomenon – number of subscribers is not exact indicator and cannot

be valid for evaluation of effects of YouTube effectiveness. It means that a lot of unsubscribed visitors have seen these clips.

Due to the recent situation with severe flooding in RS, Government of RS created also YouTube channel with aim to publish press conferences and vital information related to flooding catastrophe. Since the account was created on 17.5.2014 and it has only 23 subscribers. Despite this fact, 61 video was posted until 28.5.2014 and the clips were seen 1717 time, average 28 times per clip. Here, one can apply the same logic as in previous paragraph on number of subscribers and persons seeing the clips that are not correlating.

4. – Conclusion

Social media are very useful tool for governments in order to establish two-way communication with its stakeholders (primarily citizens and entrepreneurs). This is very important for processes of e-consultations and assistance in decision making process. Social media are useful tools for establishment of sound dialogue and for gaining of confidence that each government needs in relations with its citizens. They increase interaction between stakeholders and provide possibility for active participation of citizens and decrease of digital divide among specific groups of stakeholders.

There are numerous of benefits that government can achieve using social networks. The government can increase effective distribution of critical information to citizens and communities, whether for emergency response, education or awareness using social media. This is very typical for emergency situations. Spreading of word with social media can mobilize necessary efforts in order to help people in need (for example - natural disasters, war situations, etc.)

Using actively social media, public administration can increase public response to public programs and other actions undertaken by government, where input and feedback from citizens will help shape and improve decision making process. Better informed strategies with accurate data will lead to greater efficiency of public administration and this can be achieved with implementation of e-services that will be available at social media.

Increased use of innovative tools and services at social media are increasing level of digital literacy among population, especially in small businesses and entrepreneurs that are drivers of further innovation and prosperity. Therefore, social media have been seen as drivers of information society development, and as such deserve full attention of public administration in order to facilitate e-inclusion and other barriers in line with the implementation of information society in the country.

According to World Economic Forum and Networking Readiness Index, in BiH (thus in RS too) most of the ICT is used by individuals - citizens in their daily lives for a variety of purposes. However, results show insufficient use of ICT by business and public administration. The conclusion arising from this is that the citizens of BiH (and RS) are ready to use on-line services of the public administration. Comparing to previous years, it is possible to observe constant increase in individual use opposite to constant decrease in business and governmental use.

Although BiH started process of public administration reform at all three levels of governance, implementation is still on half-way and not satisfactory. State, entity and district levels of governance in BiH have to invest more efforts in full implementation of foreseen actions from Revised Action Plan 1 in order to establish sound basis for provision of e-services and functioning of e-government. On its road to accession to European Union, all three levels of governance need to move faster in reform of

public administration. Following the examples of neighbouring countries (Croatia and Serbia), this reform should include issues from Digital agenda and other related to such reform.

The presence of the RS public administration at both levels of government is at a very low level. Only 14 institutions, out of 84 analysed, have some form of representation at social media. These are non-systematic and unstructured attempts to use these free-of-charge platforms for mass communication, but without significant impact on stakeholders. Various factors can have influence on such attitude towards use of social media and this can be a topic for future research.

The research, which was conducted by end of 2013 and in first half of 2014, showed that most used social media by RS public administration is Facebook (8 institutions) then Twitter and YouTube (with 4 institutions per each social network) and LinkedIn (with only 3 institutions represented) It is evident that institutions started to use these social networks, but in ad hoc not systematic and structured approach. This result overlaps with actual findings of other papers dealing with this topic.

According to model of maturity of e-government produced by Gartner in 2010 [15] one can conclude that Republic of Srpska government is still in second (development) phase. The main characteristic of this phase is established synergy with social networks as the communication channel with stakeholders. The government registers Facebook or profiles at other social network and links it with own Web site. However, editing pages on social media is limited to publishing announcements, notifications and basic information. The aim of this phase is to open work of public administration to stakeholders in order to improve transparency and availability of public administration.

It remains on public administration at both levels of governance in RS, taught with examples of advanced countries, to take advantage of these free tools and platforms for promotion of their goals and ideas, and to communicate it to its' citizens in timely and accurate manner. A particular advantage is that these tools and platforms can be used to improve communication with the stakeholders for research purposes – to hear "vox populi" and to learn knowledge of citizens and their participation in decision-making processes, strengthening of e-inclusion and e-democracy.

Recent events in Bosnia and Herzegovina (flood) have proven the assumption that emergency situations are increasing use of social networks on both sides – by governments and by citizens. Some social network profiles have recorded increase of even more than 50% of followers (or friends) due to increased demand for timely and accurate information.

Moreover, it is still on-going debate on should governmental e-services be supported by social media? In line with this, a group of authors (Broughton, Higgins, Hicks and Cox, 2010.) discussed the policy and practice relating to the use of social media by employees. The assumption is that these tools are underused in other WB countries as well, and those institutions of public administration aren't use them efficiently. These, more behavioural issues, were not investigated in this paper since it requires different approach but can be interesting for some future works.

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BUSINESS-IT ALIGNMENT IN MUNICIPALITIES – THE SWISS CASE

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Abstract – Huge challenges face municipalities (in Switzerland) today, not merely as administrative units but also in the context of rapid technological development in information technology. There are calls for the increased implementation of E-government solutions. The relationship between business activities and IT ('business-IT alignment') plays a central role in this. This paper considers the relationship between the use of IT solutions and the business activities of municipal authorities in general and specifically in the German speaking part of Switzerland. In this paper we investigate business-IT alignment using a deductive method that employs a survey and the development of a simple model on the basis of which exploratory bivariate relationships between different factors can be tested. The results of the empirical survey conducted in virtually all Swiss German-speaking municipalities. Business-IT alignment is more of an issue the larger the municipality. Based on this study, it can be concluded that business-IT alignment is being implemented in the following six (IT) areas: definitions of roles, competencies, tasks and responsibilities, artefacts required for IT management, sourcing, documentation artefacts, standards and frameworks. The results show significant indications that these artefacts and subjects/roles make a significant contribution to user satisfaction and hence to business-IT alignment

1. – Introduction

1.1. – Background

From the point of view of the municipalities, there are various future challenges: these include funding shortages, demographic change, increasing complexity of IT, networking etc. (cf. e.g., Steiner (2003) on the challenges facing municipalities in general, and Walser (2012) on the opportunities for restructuring through the use of IT). There are various determinants relevant to these challenges. For example, a distinction must be made between the size of the municipalities and, where appropriate, their geographical location. Municipalities today face the challenge of adopting technical innovation, networking and E-government (Al-Sebie/Irani (2005); Swain et al. (1995); Ward/Mitchell (2007)) for the purpose of technological development, as a result of which the challenges with regard to internal or external IT and the management of IT will become greater (Nielsen/Persson (2010); Nielsen/Persson (2012)). From a technological perspective, massive changes are therefore under way in administrative organisations. The private sector has to some extent already adapted to these and thus, in some cases, has thrived and developed further (see e.g. Campbell et al. (2009)). As a result of this, customers and employees of administrative organisations are now demanding that administrative organisations also adopt these technological changes, in order to enable, for example, participation via social media, online payment and the use of tablets. Here, also in public administration, where business-IT alignment is concerned, it is the ability of the organisation to deal proactively and harmoniously with these changes that generally appear to be the formula for success (see Kraemer (1977) for a very early study of technology adaptation in public administration/Wang/Liao (2008) on E-government; Bouwman et al. (2011) on architecture issues and their alignment character, and Campell et al. (2009) for a comparative study of IT governance in private firms and the public sector). This means that the technological

developments in the form of the internet, mobile services (apps), social media, etc. increase pressure on municipalities to adequate development in this area (cf. e.g. Bonsón et al. (2012)). The range of communication and media options is changing both for citizens and organisations. The number of communication channels is rising (see, in this regard e.g., Pietersen/Johnson (2011)) and this may entail further changes for the organisation (cf. Walser (2012), amongst others). This will involve changes to the services provided by the municipalities. The management of IT thus assumes greater importance, (IT governance; cf. e.g. De Haas/Van Grembergen (2009) for its relationship with business-IT alignment); of particular relevance here is the assumption of responsibility for IT by management even in public administrative organisations (cf., e.g. ISACA (2011) in connection with this). The capacity for IT leadership and management must be available and must be improved. The question remains as to what areas and scope for action are open to municipalities, for example in the areas of sourcing or internal customer relationship management. Their business-IT relationship is of central importance for the further development of municipalities if they are to be able to overcome future challenges, particularly with regard to demographic developments (cf. e.g. Obi et al. (2013) and Plaza et al. (2011)) and IT.

1.2. - Problem statement

With the above in view, the issue of business-IT alignment, still rarely discussed in the area of public administration, is becoming increasingly important from a research perspective as well as in the public sector. In general, research into business-IT alignment in the private sector is more advanced than that in the public sector; this is likely to be due, for example, to the widely recognised (and largely positive) relationship between business performance and business-IT alignment (cf. Lye (2006), Andrews et al. (2012), Andrews/Beynon (2011)). It might be sufficient for public administration if a relationship between administrative activity compliance and business-IT alignment could be demonstrated. The backlog in research into business-IT alignment in the area of public administration is one of the reasons why this broad-based study at municipal level has been undertaken. In Germany and Switzerland the need for business-IT alignment in public administration is increasing because of the much discussed failures of IT projects in the past (cf. Mertens (2012) and Walser (2013)). Regardless of whether the concern is business-IT alignment in the private or public sector, one aspect receives little attention but is of considerable interest. It is that of which objects, roles, artefacts etc. promote business-IT alignment and the kind of business-IT alignment effects which these objects, roles and artefacts create. This is of particular interest in the light of the ability to shape business-IT alignment using relevant objects, roles, artefacts, etc. As mentioned above initial research into strategic alignment was carried out by Henderson/Venkatraman (1993) and subsequent generations of researchers (Kearns/Lederer (2000), Avison et al. (2004), Bashiri et al. (2010), Chan et al. (2006), Beimborn et al. (2009)), the further authors repeatedly refer to the model of strategic business and IT alignment as well as operational business-IT alignment outlined by Henderson/Venkatraman (1993). With this in view, this current undertaking can be justified as research that focusses more on the operational-infrastructural alignment between business activities and IT and that takes into account the fact that objects, artefacts, roles, subjects, bodies etc. can be consciously designed for the short to medium term with regard to their alignment function, although what these objects, artefacts, roles, subjects, bodies etc. are must first be determined.

1.3. - Objectives

This explorative, descriptive and bivariate study of business-IT alignment in Swiss municipalities has been carried out for the purpose of testing various hypotheses. On the one hand, the objective is to explore the relationship between the size of a municipality and the effect this has on its business-IT

alignment, while on the other hand the objective is to evaluate the effect of business-IT alignment on the satisfaction of municipality employees with their IT system.

1.4. - Methodology

This study has both, explorative and deductive character. It is based on an online survey. The reason being for this approach is, as shown in section 1.2, the relative infancy of business-IT alignment research (in public administration). There are thus limited possibilities for generating hypotheses from the literature. It is also problematic that there is insufficient usable research and literature on business-IT alignment with a focus on public administration (and that the level of maturity of relevant models and theories is also poor), which in part makes it necessary to use analogies drawn from the private sector. Furthermore, the complexity and multidimensionality of the subject further hinder research in this area. Based on the presentation of the problem statement described from a subject-specific and technical research perspective, influencing factors and objects, subjects, organisational aspects etc. are derived from individual academic articles, and are considered as design elements of business-IT alignment in municipalities. Where possible, these are directly related to a dependent business-IT alignment variable or placed in an indirect association with such. Alternatively, satisfaction of users with IT can also be used as a construct and a dependent variable. Here it must be assumed that there is a significant correlation between user satisfaction and business-IT alignment (cf. e.g. Ward/Peppard (1996); Peppard/Ward (2004); Coughlan et al. (2004)).

2. - Swiss municipalities and IT

The following sections outline basic information on the number and structure of Swiss municipalities. According to the Federal Office for Statistics (BfS), Switzerland had 2,584 municipalities in 2010. Between the censuses of 2000 and 2010, the number of municipalities in Switzerland fell by 312 (-11%). This represents an average reduction of 30 municipalities per year (see BfS (2010)). The average population of a municipality is 3’000 inhabitants (BfS (2010)). There is evidence of clear differences between the average populations of each canton, which could be attributable to the most prevalent type of municipalities in each canton. City of Basel and towns in the canton Zurich are typically high density urban municipalities. Municipalities in the cantons of Solothurn, Bern, Waadt and Aargau are characterized by rural municipalities. The municipalities in the cantons of Zürich, Geneva, Basel city are typified by agglomeration municipalities (municipalities in urban cantons or cantons in which towns are of key significance). Finally the cantons of Wallis, Graubünden and Tessin mainly contain mountain municipalities. Further key parameters of interest regarding municipalities and IT are discussed in the following. No official data was available on employee numbers of municipalities, therefore this data had to be collated for the present study. No data was available either on the number of personnel in municipalities working in IT. This information also had to be collated. No official data was available on IT budgets of municipalities, therefore this data had to be collated for the present study. The BfS registers more mergers between municipalities with low populations (BfS (2010)). By way of analogy, it can thus be concluded that IT has also been merged and consolidated through the merger of municipalities. On the other hand it can be inferred (hypothesis which has to be tested in further studies) that, regardless of municipality mergers, smaller municipalities tend to be less able to cope with IT, show less positive business-IT alignment and analogously are more likely, if need be, to outsource IT or consolidate their IT with other municipalities, as noted by Csoka (2006) on the basis of empirical research on forms of cooperation between IT departments in municipalities. The following statements about typical IT facilities of small to medium-sized municipalities are based on an interview by the primary author with a specialist for IT provision in Swiss municipalities. This IT provider operates mainly in the Swiss central plateau in the Bern area. The IT facilities in a smaller or

medium-sized municipality are typically as follows: use of specific municipality administration software (back office): based on suites or on best-of-breed components; web presence: either integrated or not within municipal back office applications; workplace: with standard functions as for instance web access, email, office products etc.; records management solutions, either integrated or not within municipal back office applications; if the municipal system does not support all municipality issues, the use of an ERP system may be necessary.

3. - Investigation of Business-IT Alignment in Swiss Municipalities

3.1. - Research methodology in detail

German-speaking Swiss municipalities were surveyed based on an online survey. Key aspects of the survey and the responses to the online questionnaire are outlined below[1]. Because of time constraints, the first investigation block was primarily descriptively analysed and then analysed for correlations with the proposed hypotheses (on which, among other things, the conclusion of this paper are largely based). All hypotheses which were rejected during analysis of the first investigation block are ignored below. In developing the survey it was necessary, because of the explorative nature of the study, to assume certain basic correlations: firstly, the size of a municipality determines the municipality's business-IT alignment and secondly, the level of business-IT alignment in a municipality influences the level of satisfaction of municipality personnel with (the) IT (solution).

3.2. - Business-IT alignment

By means of literature research, artefacts, roles, objects, subjects etc. were identified that are of relevance to business-IT alignment. These factors were taken into account when designing the municipality survey and are shown in Table 1. The relevant literature is listed in the bibliography at the end of this paper. The elements relevant to Business-IT Alignment (BIA) maturity were also identified using the literature and were summarised in groups as follows: roles, tasks, responsibilities, competencies, defining artefacts, sourcing, documentation artefacts, and standards. The size of the municipality is the key element that determines BIA maturity. The size of the municipality is defined in the present model (see Figure 3) in terms of the number of inhabitants, the number of municipality employees, the municipal budget and the IT budget. The defining artefacts group includes, for example, definitions of process steps, performance agreements with customers (service level agreements (SLA)), IT planning etc. The term 'sourcing' is a simplified blanket term for how the IT solution is operated: in its simplest form, internally or externally. Satisfaction with the IT solution is defined using various factors. Where the size of the municipality has a direct influence on satisfaction with the IT solution, then it is possible that the maturity level of BIA (as a variable in between) does not play a significant role. For this reason, a direct correlation between municipality size and satisfaction was taken into account for the purposes of the investigation.

[1] See Bigler et al. for the first study (2013). A German version (language) of the unpublished final report produced in association with a research project undertaken by Bern University of Applied Sciences and its E-government institute can be requested from the authors.

No.	Artefact	Source	Notes	No.	Artefact	Source	Notes
1	Business and IT plan	Al-Hatmi (2012)		10	Proces definitions	Andrews/Beynon (2011)	
2	Investment planning	Al-Hatmi (2012), Roberto (2008) Sawyer et al. (2008)		11	Service level alignment	Sawyer et al. (2008)	
3	IT budget	Sawyer et al. (2008)		12	Existing standards	Sawyer et al. (2008)	
4	Prioritisation of projects	Al-Hatmi (2012), Campbell (2009)		13	Project portfolio management	Roberto (2008)	
5	Performance measurements	Al-Hatmi (2012), Lye (2006)		14	Definition of organisation, roles and responsibility	Roberto (2008)	
6	Satisfaction rating (existing)	Andrews et al. (2012), Lee (2005)	E.g. Business Scorecard, ROI, NPV, IT value	15	Enterprise archit	Al-Hatmi (2012), Sawyer et al. (2008), Roberto (2008)	Organisational struc-ture, business proc., IS models, roles, bodies, software, applications
7	Documentation of IT and services	Beenstra (2012), Roberto (2008)		16	Acceptance of IT	Lee (2005)	
8	Outsourcing IT	Roberto (2008)		17	BIA maturity mod	Roberto (2008)	
9	Structure of IT	Csoka (2006)					

Table 4: Artefacts relevant to business-IT alignment (BIA) identified from the literature.

3.3. - Hypotheses

From the four types of hypotheses defined by Kornmeier (Kornmeier (2007), p. 75-79) mainly directional hypotheses were employed (e.g. 'the bigger...the better'). The hypotheses are listed and explained briefly in table 2). Hypothesis1: The larger the municipality, the better organised IT is in the municipality. This hypothesis is based on the assumption that size is a determining factor for the level of organisation of IT. 'Organisation' is here used to mean that roles are defined and that appropriate documentation is available, such as job descriptions, definitions of process steps and processes etc. Hypothesis 2: The larger the municipality, the more distinctly IT tasks, competencies and responsibilities are defined. The specific definition of tasks, responsibilities, competencies is more advanced in larger than in smaller municipalities. Hypothesis 3: The larger the municipality, the better documented the IT landscape is. This assumes that IT documentation in the sense of enterprise architectures is better maintained in larger municipalities, because the IT landscape in larger municipalities is larger and less easily understood. Hypothesis 4: The smaller the municipality, the more likely it is that IT elements and related aspects are outsourced. The assumption here is that larger municipalities manage their IT themselves and that smaller municipalities tend to work with an external provider. Hypothesis 5: The larger the municipality, the more standards are used. The implementation and ongoing use of standards is expensive and creates a lot of work, which smaller municipalities are not able to afford. It is therefore assumed that standards are primarily used in large municipalities. Hypothesis 6: The larger the municipality, the greater the level of satisfaction with the IT solution in the municipality. The assumption is that the size of a municipality influences satisfaction with its IT solution; it is possible that larger municipalities are able to procure better IT services and products. Hypothesis 7: The nature of the business-IT alignment artefacts used leads to greater satisfaction with the IT solution. The selected artefact groups which can be used to measure business-IT alignment are roles, tasks, responsibilities, competencies, defined artefacts, sourcing, documentation artefacts and standards.

3.4. - Sample and sampling method

Friedrichs, quoted in (Kromrey (2006), p. 276) defines four requirements for sampling. 1. The sample must represent a scaled-down version of the basis population; 2 It must be possible to specify and

empirically define the basis population; 3. The sampling method used must be specifiable; 4. The units or elements of the sample must be defined. Requirements 2-4 are discussed in the following section with regard to their relevance to the project. The basis population consists of 2,408 Swiss municipalities. These municipalities use the languages: German, French, Italian and Romansh. If only the German-speaking municipalities are taken into account, the number of municipalities is reduced to 1,783. There are various methods of defining a sample suitable for this survey. Kornmeier (Kornmeier (2007), p. 159) described the following methods, all of which could have been applied to our survey: systematic selection from a random starting point (e.g. every 10th municipality on the list from the random start); selection of random numbers (e.g. every round factor 10 number on a list); arbitrary selection; deliberate sampling; cut-off sampling (i.e. only municipalities with a certain size in terms of population); quota sampling (e.g. only those that meet certain criteria, such as German-speaking). The quota sampling method seemed most appropriate to this investigation (i.e. use of defined characteristics as selection criteria; Table 3). It was readily possible to obtain the email addresses of municipalities so that there were no cost-restraints in this respect (cost of purchasing email addresses) or similar. The criteria used to select the municipalities for the sample are as follows. Size is not a factor. All municipalities were contacted regardless of size. Geography is not a factor. Location played no role, municipalities across all of Switzerland were contacted. Language played the important role. The survey was limited to Germain-speaking municipalities (bilingual German municipalities were, for the purpose of this survey, also considered German-speaking). The following cantons in Switzerland are defined as German speaking (number of responding municipalities per canton/percentage): Appenzell-Ausserrhoden (5/1.5), Appenzell-Innerrhoden (0/0), Aargau (31/9.4), Basel City (0/0), Basel State (11/3.3), Bern (63/19), Freiburg (12/3.6), Glarus (1/0.3), Graubünden (12/3.6), Luzern (12/3.6), Nidwalden (2/0.6), Obwalden (4/1.2), Schaffhausen (3/0.9), Schwyz (9/2.7), Solothurn (17/5.1), St. Gallen (9/2.7), Thurgau (11/3.3), Uri (2/0.6), Wallis (6/1.8), Zug (3/0.9), Zürich (27/8.2). In order to be able to make representative statements about German-speaking municipalities as a whole, a response rate of 327 was required. This was calculated using the formula of (Kornmeier, 2007, p. 159ff). It was decided that if N= 327 was not achieved, analysis of the results would be undertaken; however the results would not be considered representative for all German-speaking (cantons and their) municipalities. Because of reasons of length of this paper, the English description of the detailed development of the questionnaire can be requested from the authors per email, and thus cannot be presented in the paper.

4. - Results of the survey on business-IT alignment in municipalities

4.1. - Structure of survey participants

This section briefly outlines the range of respondents who participated in the survey. Following a rough elimination of unsatisfactory respondents (mainly those who had simply clicked through the survey), 331 completed surveys remained. The highest proportion of these originated from Bern canton (19%) followed by Aargau canton (9.4%). Unfortunately no responses were returned from the Basel city canton. Looking at the characteristics of the municipalities (N=270), it is apparent that mainly municipalities that considered themselves rural participated in the survey (58%), followed by the agglomeration municipalities (25%), the mountain municipalities (12%), and urban municipalities (5%).

4.2. - Identification of correlations between different business-IT alignment artefacts

Prior to the actual testing of the hypotheses, correlations between the various business-IT alignment artefacts, roles and subjects were identified (Figure 8 and Figure 9). The results are shown in Figure 1 together with the relevant correlations and significance values and these are rather striking. There are particularly apparent correlations, shown as bold lines, between the following, listed in descending order of significance: tasks/responsibilities/competencies and the number of artefacts; roles and the number of artefacts; roles and documentation artefacts; the number of artefacts and documentation artefacts; roles and tasks/responsibilities/competencies; standards and the number of artefacts. The correlation between the various variables relevant to the size of the municipalities was also analysed. Figure 2 shows the correlations with the significance values. It is particularly noticeable here that the size factors all correlate significantly. Correlation coefficients of 95.7% (number of inhabitants versus level of municipality budget) and 99.2% (municipality budget versus number of employees) were generated. From this the conclusion can be drawn that the factor of size is essentially sufficient as a starting point for the investigation, e.g. the size of the municipal budget or the number of inhabitants in the municipality. This is of importance when it comes to further analysis of the data.

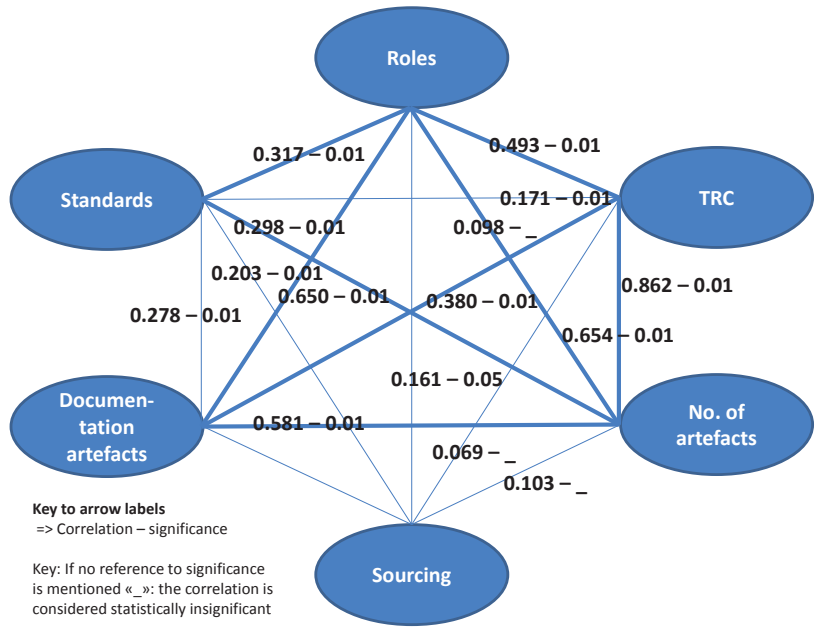

Figure 1: Identification of correlations between the various business-IT alignment artefacts.

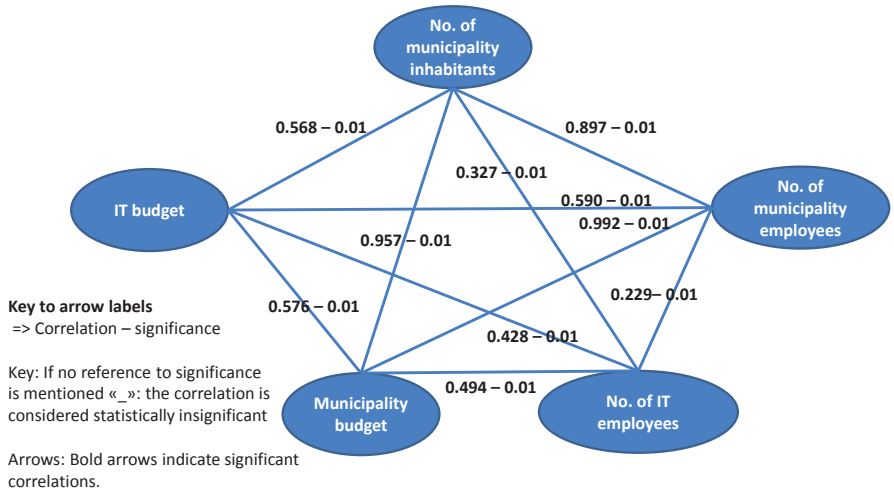

Figure 2: Identification of correlations between the various variables relevant to size of municipality.

4.3 Hypotheses testing

4.3.1. - Testing hypothesis 1

The larger the municipality, the better organised IT will be. The hypothesis is confirmed. An analysis of the data records shows that 252 municipalities responded to the question while 87 municipalities skipped the question (It was possible to mark several answers with a cross). The artefacts most frequently referred to are the following: responsibilities, roles, competencies and IT investment planning. With regard to roles specified, it is evident that only 277 municipalities responded to the question. The question was ignored or skipped on 112 occasions (It was possible to mark several answers with a cross). Nevertheless, there are specific outliers. "Financial Manager" was named most often (68%), followed by "Support" (53%) and "Availability Manager" (50%). The available data was analysed in order to determine if there is a correlation between the size of a municipality and the artefacts and the roles. It was possible to mark several answers with a cross. In the case of artefacts, there is a highly significant low correlation with the number of inhabitants, the number of administration employees, the overall municipal budget and the municipal budget for IT (varying between 19 percent and 27 percent, all with a significance of 0.01/two-sided). The number of municipal employees in IT does not correlate with the artefacts. These correlations can be explained by the fact that job descriptions and IT costs in the municipalities are important management artefacts to justify IT expenditures. These artefacts are thus present in many municipalities for this reason and become more important if the municipality grows in size. Moving to roles, these correlate positively with the municipality size characteristics number of roles, number of inhabitants, number, budget of the municipality (Pearson correlation percentage varying between 19.3 and 65.4 percent/all with a significance of 0.01/two-sided). The job title of state employees is often clearly stated. Nevertheless, it is surprising that so many roles, derived from ITIL, exist in the municipalities. The reasons for this may be that where higher budgets are available, it becomes increasingly important to clearly allocate and differentiate between tasks.

4.3.2. - Testing hypothesis 2

The larger the municipality, the more distinctly IT tasks, competencies and responsibilities are defined. Of the artefacts named under hypothesis 1, only competencies, responsibilities and tasks do not correlate with the size of the municipality (N=231; Pearson correlation: 11.8 percent, not significant). This hypothesis can thus be rejected.

4.3.3. - Testing hypothesis 3

The larger the municipality is, the better documented the IT landscape is. The hypothesis is clearly confirmed. 178 municipalities responded to the questions regarding documentation artefacts, while almost the same number (161) skipped the question (It was possible to mark several answers with a cross). Probably the non-responders had difficulties to make differentiated statements due to the descriptions used in the answer options. On the basis of the answers provided, it is clear that a description of the IT landscape (47.8%) and an IT plan (41%) are the main artefacts in use. An IT service description (39.3%) also appears to be considered important. Only 14.6% implemented a business plan. Further investigations would be needed to understand the reasons for that. One point could be, that the items were not as clearly separated one of each. If the correlation between the size of the municipality and the number of documentation artefacts in municipalities is considered, it is noticeable that for all size characteristics of a municipality, there is a mid-level correlation (varying between 23.4 percent to 41.4 percent) with a consistently high level of significance (all with significance level of 0.01). The documentation seems to be quite important in the municipalities surveyed. The larger the municipality is, the larger its IT landscape. For this reason, municipalities are forced to use documentation artefacts in order to maintain an overview of their different systems, applications, services, and interfaces. The reasons for this level of documentation could also be related to the many external service providers hired by municipalities. This relationship needs to be examined in a subsequent study.

4.3.4. - Testing hypothesis 4

Correlations between the size of the municipality and the nature of its IT operations: the question regarding where the IT solution is operated was answered by 196 municipalities, the question was skipped on 143 occasions. The distribution of answers was broad. No one answer option stands out. It can be said, however, that slightly more municipalities outsource although the difference is minimal. A follow-up question was asked about the procurement of IT services. 199 municipalities responded to this question, while 140 municipalities provided no information (probably because of more complex sourcing situations; further investigations are needed also regarding the number of 45 municipalities which set a cross at ‘other’). 'Own service partners' is clearly in first place by a considerable margin (75 percent). Only around 20% obtain their services from the canton and only 5.5% source their IT services from another municipality. A follow-up question was asked about the type of services procured. There were slightly more responses than non-responses to this question (219; it was possible to mark several answers with a cross). It can be concluded from this that the proportion of external serice procurement is a little higher than was inferred at the start of this subsection. The different forms of service procurement have been compiled and investigated by Csoka (2006) and Spicher (2007) and, for simplicity's sake, their definitions have been adopted. IT support is mostly externally procured (89%), while server hosting (78.1%), office automation (65.3%) and operation/network (58.9%) were selected by survey participants in decreasing order as being characteristic of their externally procured services. If the size of the IT solution is now compared with the answers, then it is apparent that there is a correlation between size and the operation of IT (Pearson correlations between 18.0 and 25.9 percent/number of employees, number of inhabitants, budget, IT budget; level of significance varying between 0.05 and 0.01 two-sided).

4.3.5. - Testing hypothesis 5

The larger the municipality the more IT standards and frameworks are used. This hypothesis is confirmed. The question was answered 226 times and skipped on 113 occasions (it was possible to mark several answers with a cross). It is noticeable that 81.9% do not use the standards named. Of the other standards remaining, ISO 9000 (10.6%) and ITIL (4.4%) are used most frequently. Apart from Val-IT, which has been recently integrated in COBIT 5, all standards were stipulated at least twice. For the 226 municipalities, one standard only was stipulated on 70 occasions. It is possible that the advantages of standards have not yet been recognized in the sector of municipalities or in the public administration in general. The reasons for the minimal use of standards could provide the basis for further research. If the relationship between size and standards used is now considered, it becomes clear that there is a marked correlation (with a high statistical significance > 60 percent) between the municipality budget and use of standards (Pearson correlation of 62.9 percent with a significance level of 0.01/two-sided). The Pearson correlations of the other variables (number of employees, IT budget, number of inhabitants) all vary between 34.3 percent and 50 percent, all with significance levels of 0.01/two-sided.

4.3.6. - Testing hypothesis 6

The larger the municipality, the greater the level of satisfaction with the IT solution. This hypothesis is rejected. If the descriptive statistical characteristics of satisfaction with IT are considered, it is noticeable that satisfaction is already very high. The mean coefficient for satisfaction is 3.397, i.e. between satisfied and very satisfied. The lowest value is 2.11 - i.e. unsatisfied (N=331). Standard deviation is as follows: 0.337. When analysed in terms of the different forms of municipalities, the following picture of level of satisfaction emerges. The correlation analysis shows, that service or customer satisfaction with IT services is not correlated with the variables concerning municipalities, as for instance municipality budget, IT budget, number of administration employees, number of municipality employees in the IT department.

4.3.7. - Testing hypothesis 7

Selected artefacts result in improved satisfaction with a municipality's IT. The hypothesis is partially accepted. Three of the six areas have an influence on satisfaction with IT. These are the existing roles in a municipality (Pearson correlation of 12.6 percent, with a two-sided significance level of 0.05), number of IT documentations (Pearson correlation of 13.9 percent, with a two-sided significance level of 0.05) and the numbers of standards/frameworks in use Pearson correlation of 11.6 percent, with a two-sided significance level of 0.05).

5. - Summary and outlook

5.1. - Summary

Municipalities, not only in Switzerland, face huge challenges today, not merely as administrative units (in terms of demographic change, shortage of funds, etc.) but also in the context of rapid technological development in information technology, E-government etc. There are calls for the increased implementation of E-government solutions and this is being realized albeit at a fairly slow pace, additionally internal processes are slowly being implemented, or where they already exist rationalised, automated and electronically supported. IT management plays more and more of a central role in business activities and therefore the alignment between these activities and IT is of critical importance. This paper considers the level of business-IT alignment in municipalities based on various variables relating to municipality size, artefacts that underpin business-IT alignment, and the satisfaction of the

municipalities with IT services in Switzerland. This paper investigates business-IT alignment using a deductive approach that employs a survey and the development of a behavioral model on the basis of which exploratory bivariate relationships between different factors can be tested. The results of the empirical survey conducted in (but not responded to by all) the Swiss German-speaking municipalities are as follows. Implicitly or explicitly, business-IT alignment is more of an issue the larger the municipality (i.e. number of inhabitants). Based on this study, it can be concluded that business-IT alignment is being implemented in the following six areas: role definition in all aspects of IT, definition of competencies and responsibility, the definition of the artefacts required for IT management, sourcing, documentation of IT artefacts, standards and frameworks (and their use). The results show significant indications that these artefacts and subjects/roles make a significant contribution to user satisfaction and hence to business-IT alignment. The implementation of such artefacts does not affect the satisfaction of the IT service users in the municipalities with their IT services. In general, it should be noted that the N values resulting from the survey were not sufficiently large enough for accurate testing of the hypotheses due to respondents skipping questions. For this reason, it is not possible to draw general conclusions from the results. Hypotheses 1, 3, 5 and 7 (partly) are confirmed.

5.2. - Outlook

In this section, we consider the need for further research in view of the results obtained by this investigation. Firstly, we discuss the need for further research with specific focus on this investigation's results, and then we consider the more general need for further research. Further research on the issue should take the form of more detailed and extensive analysis of the postulated correlations outlined in this paper. The following fundamental question arises: Is it actually possible to postulate and measure a positive or negative relationship with an IT service on the basis of role definitions, standards and documentation of IT? A further survey of IT providers would be advisable in order to complement this study with insights from the IT service provider perspective on business-IT alignment. . Further, since IT services are often delivered by external providers, another line of questioning that should be pursued is how business-IT alignment might be designed and improved in collaboration with external suppliers. At present, only very few IT standards and frameworks are used in municipalities and this also requires further investigation. Is too little known about standards, or are there other reasons that might explain why they are largely ignored at the municipal level? Is there a lack of a steering model in public administrations IT which makes the use of standards and frameworks unnecessary? Are the costs of the introduction and maintenance of standards too high for public administrations? In view of the results of this investigation, there is also the question of what IT standards or reference models would be suitable for use in municipalities, and what benefits would arise through the introduction of such standards or frameworks. In the following, the more general need for further research is discussed based on this investigation. Our bivariate investigation results are to be treated with caution. From a statistical viewpoint it is not allowed to discuss several of the bivariate relationships inter-related. If the data were to be reanalysed using multivariate techniques more robust findings are likely to result (e.g. based on a structural equation model; the present data can clearly be used for that purpose). The only downside to this is that the number of responses received was not the same for all questions. Theoretically, however, an attempt could be made to derive an additional parameter for business-IT alignment maturity from our dataset, so that additional conclusions concerning the maturity level of business-IT alignment could be drawn. Also of interest is the structure of public administration's management model and also the impact this management model (which of course will be different to that used in the private sector)) will have on business-IT alignment. A further subject for investigation is the potentially different nature of administration-specific culture, attitude and behaviour in comparison to the private sector and the differences which result in terms of business-IT alignment. It may also be noted as a justification for further research that it is still largely unclear as to how, and to

what extent the elements of business-IT alignment identified in this paper really explain the current situation in the municipalities. It is conceivable that there are additional factors/elements that influence BIA that have not yet been taken into account (e.g. the effect of committees/boards) and that these could significantly affect the assumptions behind this study and so need to be included for the purposes of future investigation.

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MOBILE GOVERNMENT SYSTEMS IN CROSS-BORDER ENVIRONMENTS

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In this paper, we consider a possible model of secure m-government systems based on secure mobile application and SOA-Based central platform in different cross-border envieonments. The model additionally consists of external entities, such as: PKI (Public Key Infrastructure) server, XKMS (Xml Key Management Service) server, Authentication server and Time Stamping server. The proposed model could be used in different local and/or cross-border m-government scenarios but the stress is posed on the cross-border ones. As a possible example of described secure mobile application we experimentally evaluated a secure Android based Web services application.

1. – Introduction

This work is related to the consideration of possible secure m-government model in cross-border scenarios and applying a secure Android Web services based application in it. An overview of possible secure m-government systems realized according to the similar model based on secure JAVA mobile Web service application and the SOA-Based central platform is given in [1], [2], as well as in a cross-border case in [3]. In the mentioned papers [1], [2], [3], the similar model is conceptually and theoretically presented and evaluated. An application of secure android mobile application in the proposed model is given in [4]. In this paper, as an extension of the previous work given in [3], [4], a possibility of using the secure Android based mobile application in the proposed secure m-government model in the cross-border scenarios is considered and experimentally evaluated.

First, we consider a possible model of secure SOA-based m-government online systems, i.e. about secure mobile communication between citizens and companies with the small and medium government organizations, such as municipalities and/or different state agencies. This model could be considered in both local and cross-border case. The latter means either crossing borders of municipalities in the same country or crossing borders between countries (e.g. some municipalities in different countries). This model could be suited to many different domains such as m-banking, etc. However, due to its emphasis on security, we believe it is best suited to the m-government systems.

As a main goal of this paper, we consider a possible usage of the Android-based secure mobile Web service application in the proposed secure cross-border m-government model. A feasibility of using such Android based secure mobile application is experimentally evaluated in the paper.

The paper is organized as follows. Information about some related work in literature is given in Section 2. The architecture of the proposed model is given in Section 3, while some m-government scenarios in local and cross-border cases are presented in Sections 4 and 5, respectively, through residence certificate request as an example. Some experimental results obtained by the secure Android-based application is given in Section 6 while conclusions are given in Section 7.

2. – Related Work

Security operations in electronic business (e-government, e-banking, e-commerce, e-payment, etc.) and mobile business (m-government, m-banking, m-commerce, m-payment, etc.) systems are mostly based on two secure actions:

- Strong user authentication and
- Transaction authorization.

In the proposed model, the strong user authentication is based on the X.509v3 digital certificate as unique identifiers of users. Regarding the transaction authorization, it is based on digital signature of the electronic documents with additional usage of the timestamping. Since both choices represent techniques of the highest cryptographic level which are required in the government based systems, we believe that this model is the best suited for m-government systems. Besides, in the proposed model, we use the encryption technique (WS-Encryption) in order to preserve confidentiality of information transmitted which represents an additional reason why this model is the best suited for m-government systems.

There are no many similar works in the literature. One work worth mentioning is the session based Web application system presented in [5]. Compared to a session based Web/application platform, presented in [5], in this paper we proposed a usage of the SOAP-based request-response technologies which is much better fitted to mobile environment. The model proposed in this paper could have following advantages compared to the model given in [5]:

- Web service based request-response system is much more efficient system in the mobile environment than the session based Web application system. Especially when some back office processing (government legacy systems) needs to respond on the user requests.
- Web service based model provides much more flexibilities and an easier way to implement all security features (e.g. XML security, WS-Security, Time Stamping, XKMS, PKI) compared to the Web based solution.
- Web service based system provides much more flexibilities compared to the session based Web application system in cross-border scenarios when business process includes also some processing of the user request outside of the contacted government organization.

Also, there are some conceptual discussions about security issues in the m-government systems, given in [6]. In this paper, we go further in experimental approving the usage of the secure Android mobile application in the context of complex m-government model presented in this paper.

Compared to the m-government system based on mobile qualified electronic signature in Austria [7], where the mobile phone is used as a strong user authentication tool and where a server based signature is employed (user's private key is on the HSM on server side – generated and used), our proposed model is based on the „fat" client on the mobile user side where all cryptographic mechanisms are implemented in the Android based secure mobile application. Thus, the system implemented in [7] has emphasized on the authentication part of the security operations and for the transaction authorization it is implemented on the server side. In our model, both activities, strong user authentication and transaction authorization are done by using security mechanisms implemented in the mobile application. Thus, our model is much more suited to qualified electronic signature paradigm which is

based on principle that only client based signature could be the qualified one. Namely, the authors of this paper, as well as majority of EU countries, have opinion that the server-based signature could not be the qualified ones according to the current EU regulations.

Also, compared to some LSP (Large Scale Pilot) projects, e.g. STORK [8] and STORK 2.0 [9], where some very complex interoperability authentication model is proposed, our proposed model could be more comprehensive and complete since the STORK models are mostly based only on user authentication mechanisms and their interoperabilities in cross-border usage. Unfortunately, there are no much discussions about possibilities of transaction authorization in the cross-border case.

Besides the above mentioned references, the authors of this paper could not find similar works in the literature related to mobile government systems based on Web services and Android clients. Thus, unfortunately, the presented experimental analysis does not contain a comparative analysis to other achievements from the literature.

3. – Proposed Secure M-Government Model

The proposed m-government model depicted in Fig. 1 consists of:

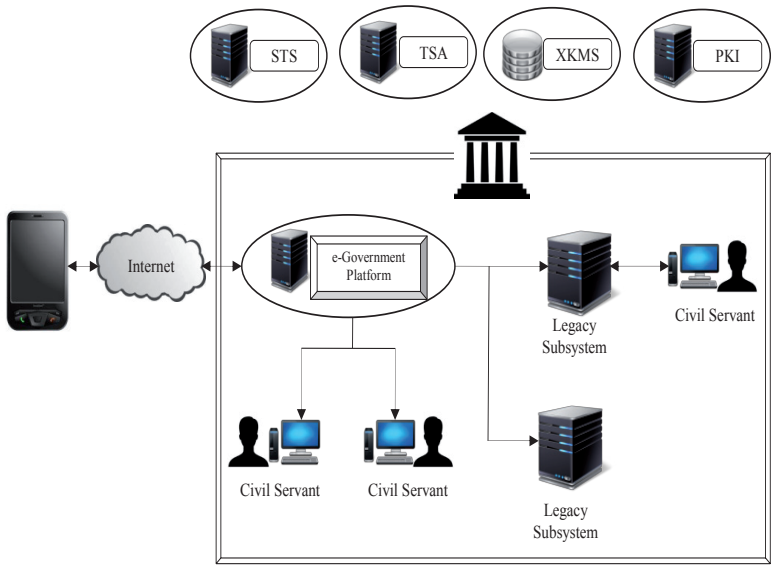

Figure 1: A proposed m-government model

- **Mobile users** (citizen, companies) who send some Web services requests to m-government platform for a purpose of receiving some government documents (e.g. residence certificate, birth or marriage certificates, etc.). These users use secure mobile Web service application on their mobile devices (mobile phones, smart phones, tablets, etc.) for such purpose.

- **SOA based Web service endpoint implementation** on the Platform's side that implements a complete set of server based security and business features. Well processed requests with all security features positively verified, the Web service platform's application proceeds to other application parts of the proposed SOA-Based platform, e.g. including the government Legacy system for issuing actual government certificates requested.
- **External entities** such as: PKI server with XKMS server as a front end, the Authentication server, and TSA (Time Stamping Authority).

Functions of the proposed external entities are following:

- **PKI server** is responsible for issuing PKI X.509v3 electronic certificates for all users/entities in the proposed m-government model (users, civil servants, administrators, servers, platforms, etc.). Since some certificate processing functions could be too heavy for mobile users, the PKI services could be exposed by the XKMS server which could register users, as well as locate or validate certificates on behalf of the mobile user. This is of particular interests in all processes that request signature verification on mobile user side.
- **Authenticaion server (e.g. STS (Security Token Service))** is responsible for strong user authentication based on PKI X.509v3 electronic certificate issued to users and other entities in the proposed model. Possible communication between the authentication server and the user's mobile Web service application could be SOAP-based and secured by using WS-Security features. Possible scenario is that, after the successful user authentication, the STS server issues a SAML token to the user which will be subsequently used for the user authentication/authorization to the Web service of the proposed m-government platform. The SAML token is digitally signed by the STS server and could consist of the user role for the Platform's user authorization. The alternative is that it could be a general-purpose Authentication server which will authenticate users by using any kind of authentication credentials, such as: username/password, OTP, PKI digital certificates, etc. In the latter case, there could be possible Web service based communication between the SOA-based central platform and the authentication server in order to authenticate users.
- **TSA server** is responsible for issuing time stamps for user's requests as well as for platform's responses (signed electronic documents). Time stamping of requests/documents could be requested from users, from the platform or from both entities.

The m-government scenarios sequence diagram for local and cross-border case by using the proposed model is given on Figure 2 [1].

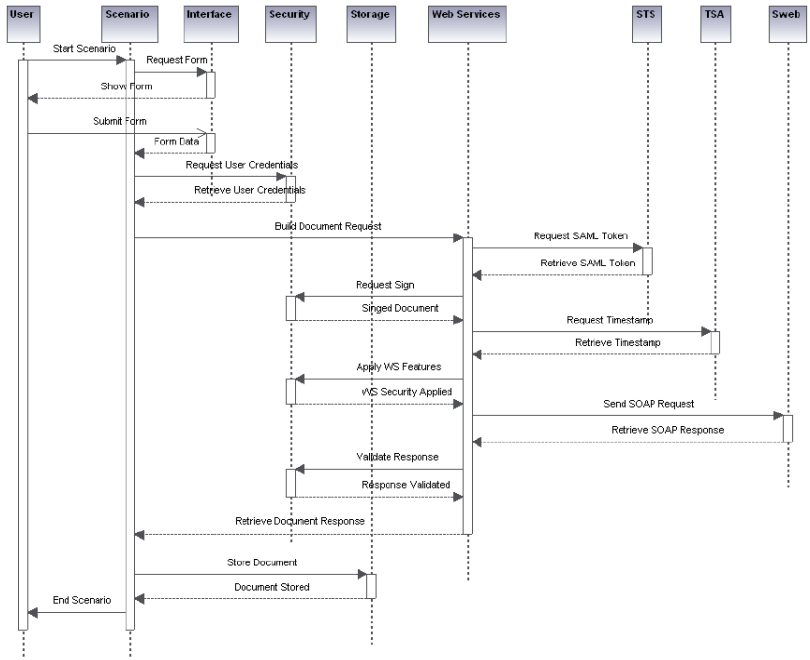

Figure 2: m-government scenario sequence diagram

As we said before, in the proposed model, the strong user authentication is based on the X.509v3 digital certificate as unique identifiers of users. The corresponding asymmetric private/public keypair is generated and stored on mobile device, either in a keystore or in some hardware security element (e.g. SIM card, microSD memory card with a smart card chip integrated, etc.). This is rarely used even in e-government systems. Especially in m-government systems this kind of strong user authentication is not used because it is mostly considered too complex and too inefficient for mobile environment. In the experimental section of the paper, based on specificities of Android application development, as well as based on implemented our optimization techniques related to applied cryptographic libraries, we will show that cryptographic techniques applied in this model are feasible and even more their realization is comparable with implementations on personal computers.

Regarding the transaction authorization, it is based on digital signature of the electronic documents with additional usage of the timestamping. Since both choices represent techniques of the highest cryptographic level which are required in the government based systems, we believe that this model is the best suited for m-government systems. Besides, in the proposed model, we use the encryption technique (WS-Encryption) in order to preserve confidentiality of information transmitted which represents an additional reason why this model is the best suited for m-government systems. Again, they are also rarely used even in e-government systems. Especially in m-government systems this kind of transaction authorization is not used because it is mostly considered too complex and too inefficient for mobile environment. In the experimental section of the paper, based on specificities of Android

application development, as well as based on implemented ouroptimization techniques related to applied cryptographic libraries, we will show that cryptographic techniques applied in this model are feasible and even more their realization is comparable with implementations on personal computers.

4. – Local m-Residence Certificate Request Service Scenario

As a possible usage of the proposed m-government model, we will first describe a possible local certificate request service scenario where a citizen requests a government document (e.g. birth, marriage, residence certificate, etc.) from his original municipality of residence. In this case, it will be a residence certificate as an example (see Fig. 2).

Prerogatives for usage of this scenario is that the user has a mobile applications on his mobile phone activated which includes generation of the asymmetric keypair (private and public key) and obtaining the user X.509v3 digital certificate from the PKI system via exposed PKI registration function through the XKMS server. The obtained digital certificate is stored in the application, as a possible example. The activation of the user's private key requests presentation of the user PIN (or password) which could be the same for accessing the mobile application itself or different.

The local scenario workflow is a following. A citizen of city A needs a certification for his principal residence in city A. He will contact the municipality of city A for that. In this process, he sends a request to this municipality first. The municipality creates his residence certificate. He gets a final notification message and can pick up his residence certificate in electronic form afterwards.

In a more detailed view, there are three system objects belonging to the municipality. It is the platform, the local ICT Infrastructure (Legacy system) and the civil servant as the human actor. The citizen sends his request to the platform, which in return first sends a notification back about the incoming request and then forwards the request to the civil servant for approval. This phase starts with the creation of an electronic document that contains the service request. Specifically, the mobile user activates the mobile application and fills in the required fields in the predefined sequence of electronic forms. When ending this process the mobile application automatically creates a residence certificate request. The user by using the secure mobile application digitally signs the request by using the asymmetric cryptographic algorithm with the user's private key (XML signature).

The next step involves the creation of a request to the TSA, in order to obtain a valid timestamp token for this request. The mobile application automatically creates this request, while previously creates a hash value of the final request (or of the signature of the request). It attaches the hash value of the request in this message and dispatches it to the TSA. The TSA processes the received request, issues a valid timestamp token and responds to the mobile device with the signed and time stamped hash value of the request (timestamp). Once the residence certificate request has been digitally signed, the mobile application creates a SOAP message and embodies the signed document into it, as well as the received timestamp. In addition, the secure application embeds the received SAML authentication and authorization token for accessing the selected m-government service. This SOAP message is the one that will be sent to the platform. The next step for the mobile application is to apply automatically strong security features on the message (WS-Security – WS-Encryption) and to dispatch it to the platform.

When receiving the SOAP message from the user, the platform needs to do all cryptographic verfication activities before accepting the request to process. This includes: verification of WS-

Encrytion amd XML signature mechanisms, then the platform does signature verification of the request as well as verification of the timestamp token. After that, the platform verifies the SAML token (or authenticate the user via a general purpose authentication server) and authenticate/authorize the user to the platform. After all succesful verifications, the platform sends the WS secured SOAP message to the user as a notification that the request is accepted for processing. The notification message consists of the result of the user authentication and the authorization as well as of TaskID which could be used to retrieve information about status of the request.

After this, the request is sent to the legacy system, where the electronic version of the residence certificate is created. After that, the civil servant has to approve this residence certificate. Furthermore, there is a final notification sent to the user mobile phone to inform the citizen that he can pick up his electronic version of the residence certificate from the SOA based platform. Finally, the residence certificate electronic document needs to be retrieved by the citizen from the m-government platform using the document retrieval service (see Fig. 1). All message exchanged between the user mobile application and the platform are protected with digital signature, timestamp and WS-security cryptographic measures.

5. – Possible Cross-Border m-Residence Certificate Request Service Scenario

In this Section, as an additional possible example of usage of the proposed model, a detailed residence certificate request workflow for the cross-border communication between two m-government platforms (or in a case of two municipalities in one country) is described. A local m-residence certificate request flow is described in [1], [2], [3], and in the previous Section. This workflow describes activities performed in a case when the user (citizen) registered in the so-called "Home Municipality" (the original municipality of residence) requests a residence certificate electronic document from the municipality (called "Serving municipality") where he/she temporarily work.

In order to make description more clearer, we will first list entities involved in the cross-border workflow:

- Mobile user with secure web service mobile application and which requests some legal document from Serving Municipality where he works
- Serving Municipality – from which the mobile user requests a legal residence document in a form and language of this Municipality
- Home Municipality – original Municipality of residence for this mobile user which will issue the requested residence certificate electronic document
- Platform's Web services – web services of both platforms (Serving and Home) as a front ends for receiving user requests
- Legacy systems from both municipalities. Legacy system of the Home Municipality will issue the requested residence certificate document
- Civil servants of both municipalities
- External entities already mentioned (STS, TSA, XKMS, PKI)

The possible steps of the cross-border workflow are (details could be found in [3]):

1. The mobile user starts the secure web service mobile application and logs in with a PIN.

2. Then the user sends request for a residence certificate to the Serving Municipality.
3. The Web Service front end (the Platform) of the Serving Municipality receives the SOAP message with the residence certificate request from the user's secure mobile application and processes it.
4. The platform of the Serving Municipality authenticates and authorizes the user for this request and sends a replying WS-Secured SOAP message to the mobile application with the result of the authentication and authorization. This step involves usage of the central Authentication server either as the SAML-based STS or a general purpose authentication server. If the authentication and authorization was successful then the SOAP message additionally contains the unique TaskID, allocated to the request, which will be referred afterwards in order to retrieve the residence certificate or an error message or to obtain a status of the request. The mobile application receives the SOAP message, stores it after successful verification all cryptographic measures. If the user authentication or the authorization failed then the workflow stops.
5. The Platform of the Serving Municipality checks if the request could be processed locally or needs to be redirected to the m-government platform (the platform) of another municipality. In this cross-border scenario the request cannot be processed locally and must be redirected to another platform – to the Home Municipality Platform.
6. This action of redirection or forwarding the user request to the Home Municipality is the same as in the local case, except that the Serving Municipality plays a role of the user and the Home Municipality is the processing government agency. Other steps are the same, i.e. requesting the SAML token from the STS for the Serving platform, timestamping of the request and applying all security measures on the request (XML signature and WS-Encryption)
7. The Platform of the Home Municipality receives the WS-Encrypted SOAP message from the Platform of the Serving Municipality and processes it. If the validation of WS-Encryption features fails on this step then the workflow stops. If it is successful, the workflow continues.
8. The Platform of the Home Municipality authenticates and authorizes the Serving Municipality and if it is successful sends a reply WS-Secured SOAP message to the Platform of the Serving Municipality with the result of the authentication and the authorization. If the authentication and authorization was successful then the SOAP message additionally contains the unique TaskID_SM (TaskID from Home Municipality), allocated to the request, which can be potentially referred afterwards in order to retrieve the status of the request.
9. The Platform of the Serving Municipality receives the reply SOAP message from the Home Municipality and processes it: if the SOAP message contains the TaskID_SM then the Task_ID of the user request is updated; if the SOAP message contains the error message then the Platform of the Serving Municipality sends an SMS (notification) with the error to the mobile user; the mobile user receives the SMS;
10. The Platform of the Home Municipality checks, can the request from the Serving Municipality be processed locally. In this scenario the request is to be processed locally by the Home Municipality.
11. The Platform of the Home Municipality sends the request to its Legacy System which processes it. Then the Platform of the Home Municipality receives the electronic document (user's residence certificate or negative response) from the Legacy System.

12. The civil servant of the Home Municipality puts a smart card in a smart card reader connected to a desktop computer and from the Web browser accesses the Platform over a SSL connection with client authentication (based on its X.509v3 digital certificate). If the connection is established then the Civil Servant is authenticated to the Platform.
13. The civil servant of the Home Municipality requests and receives from the Platform the List of Pending Documents and selects the document (residence certificate or negative response) from the list of pending documents and then verifies, edits (if required) and digitally signs it.
14. Now, the Platform of the Home Municipality should send the signed residence certificate to the Platform of the Serving Municipality. This is done in absolutely the same way as before by contacting external entities (STS, TSA) and applying security features (XML Signature and WS-Encryption). Now, the Platform of the Home Municipality plays a role of the sender and the Serving one of the receiver.
15. The Platform of the Serving Municipality receives the WS-Encrypted SOAP message from the Platform of the Home Municipality and processes it. If the validation of WS-Encryption features fails on this step then the workflow stops.
16. The Platform of the Serving Municipality authenticates and authorizes the Platform of the Home Municipality and if it is successful stores the received document (residence certificate or negative response) in the corresponding task according the TaskID SM and TaskID.
17. The Platform of the Serving Municipality sends a reply SOAP message to the Platform of the Home Municipality with the result of the authentication and the authorization.
18. If the civil servant of the Serving Municipality has not established already a SSL connection with the platform of the Serving Municipality then: the civil servant puts a smart card in a smart card reader connected to a desktop computer and from the Web browser accesses the platform over a SSL connection and if the connection is established then the civil servant is authenticated to the Platform via its X.509v3 electronic certificate
19. The civil servant of the Serving Municipality requests and receives from the Platform the List of Pending Documents, selects the received residence certificate (or negative response) from the list of pending documents and then verifies it. If the verification is successful, the civil servant of the Serving municipality digitally signs this document too.
20. The Platform then applies a procedure for timestamping of the signed electronic document.
21. The Platform of the Serving Municipality sends a SMS message (notification) to the mobile user in order to inform him/her that the residence certificate requested by the request number TaskID is ready for download or that the request with the TaskID was rejected and the official denial document (negative response) is available for download.
22. The mobile user receives the SMS notification that the processing of the request is finished and the resulting document is ready for download.
23. The mobile user starts the mobile application if it is not started yet and logs in (see the step 1) and sends the request for the resulting electronic document (residence certificate or negative response) in the same way as he sent the first request.
24. The Platform of the Serving Municipality receives the SOAP message from the mobile application and processes it

25. The platform of Serving Municipality authenticates and authorizes the user for this document download request and sends a reply WS-Secured SOAP message to the mobile application with the result of the authentication and authorization. If the authentication and authorization was successful then the SOAP message additionally contains the signed and timestamped electronic document (residence certificate or negative response).
26. The mobile application receives the WS-Encrypted SOAP message with the electronic document and processes it in the following way: the mobile application receives the WS-Encrypted SOAP message; the mobile application decrypts the SOAP message by using the user's asymmetric private key to decrypt the symmetric key used to encrypt the message and decrypt this by using this symmetric key; If the decryption is successful, then the mobile application extracts the body of the SOAP message and validates the signatures of the TSA server and of the civil servants. This is also followed by validation of certificates of the TSA server and civil servants which is done by the help of XKMS server.
27. If all mentioned verifications and validations are successful, then the mobile application stores the obtained residence certificate in electronic form in its secure repository. The user could present it to some institutions in the country where he works.

The workflow is finished.

Also, in order to apply the above mentioned cross-border m-government model some obvious prepositions must be fulfilled:

- There should be a network of connected municipality Platforms, known to the mobile applications and Platforms, or the user must enter into the mobile application the URL of Platforms of the Serving and Home Municipalities.
- There should be also network of connected STS, TSA, XKMS servers which will be used by the secure mobile applications and Platforms themselves.
- Also, there should be PKI cross certification applied between the countries with connected municipalities in order to trust all PKI X.509v3 digital certificates used by mobile users, civil servants and Platforms themselves.

6. – Experimental Analysis

This Section is dedicated to the experimental analysis of the cryptographic operations implemented on Android mobile phone, i.e. smart phones with Android operating system [10], as a possible example of the proposed secure mobile client application. Also, the proposed model and presented experimental results on Android mobile operating systems represent an m-governmenet extension compared to the discussion presented in [11]. The presented experimental results are generated using devices (mobile phone, tablet, PC laptop and PC desktop) described in [4].

Namely, we compared experimental results obtained on some mobile devices (smart phone, tablet) with the same experiments obtained on the PC computer in order to test feasibility of the analysed PKI functions implementation on mobile devices.

The presented experimental results are generated using following devices:

1. LG E610 mobile phone that has following characteristics (hereafter Mobile Phone): (CPU Core: ARM Cortex-A5, CPU Clock: 800 MHz, RAM capacity: 512 MB, Embedded Operating System: Android 4.0.3 Ice Cream Sandwich, NFC Functions).
2. Tablet Ainol Novo 7 Paladin device that has following characteristics (hereafter Tablet): (CPU Core: XBurst CPU, CPU Clock: 1 GHz, RAM capacity: 1 GB, Embedded Operating System: Android 4.0.1).
3. PC Desktop Computer that has following characteristics (hereafter PC Desktop): (CPU Core: Intel Pentium CPU G620, CPU Clock: 2.60 GHz, RAM capacity: 2 GB, Operating System: Windows XP with Service Pack 3).
4. PC Laptop computer that has following characteristics (hereafter PC Laptop): (CPU Core: Intel Celeron CPU P4600, CPU Clock: 2 GHz, RAM capacity: 3 GB, Operating System: Windows 8).

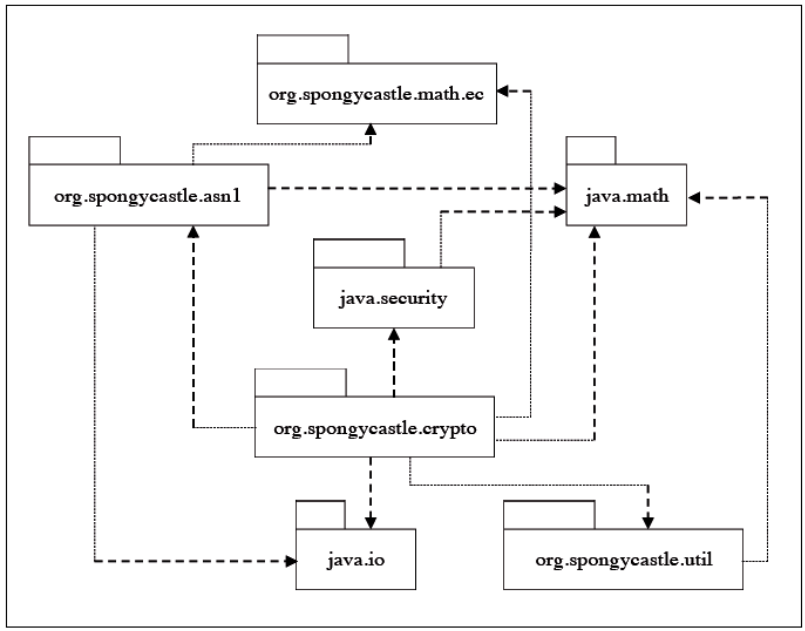

Figure 3: Lightweight Spongy Castle API Package structure

The Android platform ships with a cut-down version of Bouncy Castle - as well as being crippled. It also makes installing an updated version of the libraries difficult due to class loader conflicts. The different versions of Android operating system have implemented different versions of Bouncy Castle library releases. In order to avoid lack of interoperability between different devices that have implemented different operating systems and get more flexible code we used Spongy Castle functions [12]. A simplified package structure of the Spongy Castle package is illustrated in Figure 3.

The Spongy Castle package contains low-level lightweight API implementing all the underlying cryptographic algorithms and a provider for the Java Cryptography Extension and the Java Cryptography Architecture. The basic package that supports the cryptographic algorithms and padding schemes is the org.spongycastle.crypto package. The org.spongycastle.asn1 package supports the parsing and writing ASN.1 objects, which is useful in processing X.509 certificates. The utility classes in org.spongycastle.util can be used for producting and reading Base64 and Hexadecimal strings. The utility is useful if the ciphertext is required to be displayed as a Base64 string.

In order to achieve smaller and faster implementation we partly modified Spongy Castle functions. The modification of Spongy Castle funtions is achieved in org.spongycastle.jce package. We don't want to use JCE functionalities of genuine Spongy Castle implementation because that adds a significant memory overhead. In order to avoid using the heavyweight provider for the Java Cryptography Extension (JCE) that contains implementation of many unnecessary functions we cut off many functions and implemented only necessary ones. We directly call necessary Spongy Castle functions without using java.security.Provider functionalities at all. Using this approach we got smaller and faster code. Because mobile devices have limited resources, an application designed for mobile devices should be as compact as possible. An obfuscator is a useful tool for minimizing the size of an application. We used ProGuard obfuscator that shrinks, optimizes, and obfuscates code by removing unused code and renaming classes, fields, and methods with semantically obscure names. The result is a smaller sized .apk file that is more difficult for being reversely engineered.

Experimental results that are presented in this Section are based on such modified version of Spongy Castle functions. During testing phase we have measured an average time by using certain number of iterations. The actual number of iterations used is shown in each table. The same code and packages are used during testing procedure in all devices. Throughout this Section, all presented experimental results are given in miliseconds – ms. In order to evaluate the possibility of using the mobile phone for mobile client application in m-government systems based on Web service we measured times needed for creation of XML-Signature and Web Service (WS) Signature (Table 1, Table 2), respectively. In all these experiments, we used a file of 1KB and SHA-1 hash function. The time needed for verification of WS-Signed message is shown in Table 3.

Table 1: XML-Signature creation

Device	RSA public key length (bits), n=50000 iterations				
	512	1024	2048	3072	4096
Mobile Phone	29.64 ms	38.15 ms	95.87 ms	228.20 ms	479.10 ms
Tablet	59.73 ms	73.78 ms	144.08 ms	319.65 ms	586.54 ms
PC Laptop	2.12 ms	9.38 ms	58.50 ms	181.54 ms	414.74 ms
PC Desktop	1.57 ms	7.05 ms	43.85 ms	137.87 ms	312.79 ms

Table 2: WS-Signature creation

Device	RSA public key length (bits), n=50000 iterations				
	512	1024	2048	3072	4096
Mobile Phone	63.76 ms	74.51 ms	131.00 ms	266.29 ms	507.47 ms
Tablet	126.99 ms	147.68 ms	216.81 ms	384.48 ms	663.93 ms
PC Laptop	2.79 ms	10.07 ms	59.18 ms	182.1 ms	415.19 ms
PC Desktop	2.02 ms	7.50 ms	44.57 ms	138.03 ms	311.66 ms

Table 3: WS-Signature verification

Device	RSA public key length (bits), n=50000 iterations				
	512	1024	2048	3072	4096
Mobile Phone	34.67 ms	34.81 ms	34.87 ms	34.94 ms	50.20 ms
Tablet	94.83 ms	95.61 ms	101.27 ms	107.58 ms	111.22 ms
PC Laptop	0.88 ms	1.16 ms	2.42 ms	4.58 ms	7.29 ms
PC Desktop	0.61 ms	0.84 ms	1.74 ms	3.29 ms	5.31 ms

We also considered possibilities of communication with Timestamp Server in order to obtain the timestamp token (Table 4). During the tests we measured time needed for the following processes: Extraction of Signature Element from XML-Signed (or WS-Signed) message; Calculating SHA-1 hash value of the content of extracted Signature element; Creation of appropriate TimeStamp Request message according to RFC-3161; Sending TimeStamp Request message to TimeStamp Server; Receiving, processing and extraction of generated TimeStamp Token created by Timestamp Server.

During the experiments, we have used the following public Time Stamp servers:

1. http://tsa.starfieldtech.com (see Column 1 in Table 4);
2. http://services.globaltrustfinder.com/adss/tsa (see Column 2 in Table 4);
3. http://tsp.iaik.at/tsp/TspRequest (see Column 3 in Table 4);
4. https://timestamp.geotrust.com (see Column 4 in Table 4).

Table 4: Communication with Time Stamp Server

Device	URL address of TimeStamp Server, n=1000 iterations			
	1	2	3	4
Mobile Phone	508.07 ms	230.98 ms	179.30 ms	906.80 ms
Tablet	487.84 ms	226.49 ms	174.52 ms	876.94 ms
PC Desktop	481.61 ms	196.84 ms	148.22 ms	665.34 ms

We also considered possibilities of communication with XKMS Server in order to get verification status of X509 certificate. In order to implement above mentioned operations we have used two XKMS functions: ValidateRequest and LocateRequest. During the tests we measured the time needed for the following processes: Creation of appropriate XMKS message: LocateRequest (Table 5), ValidateRequest (Table 6); Creation of SOAP based message that encapsulates content of above mentioned XKMS message; Sending appropriate SOAP based message (LocateRequest, ValidateRequest) to XKMS Server; Receiving, processing and parsing of response message created by XKMS Server. During implementation of the above mentioned experiments, we have used the following online EJBCA servers that have implemented XKMS service:

- http://www.infrax.si/ejbca/xkms/xkms;
- http://ca.halman.net:8080/ejbca/xkms/xkms;
- http://ca.clhs.kiev.ua:8080/ejbca/xkms/xkms.

Table 5: XKMS message LocateRequest

Device	RSA key length (bits)	Host name of XKMS service, n=1000 iterations		
		www.infrax.si	ca.halman.net	ca.clhs.kiev.ua
Mobile Phone	1024	202.3 ms	136.48 ms	211.09 ms
PC Desktop		150.28 ms	92.26 ms	177.06 ms
Mobile Phone	2048	210.99 ms	141.35 ms	215.68 ms
PC Desktop		157.42 ms	95.48 ms	178.58 ms
Mobile Phone	3072	213.74 ms	146.79 ms	220.50 ms
PC Desktop		160.73 ms	98.81 ms	183.78 ms
Mobile Phone	4096	229.78 ms	152.34 ms	225.95 ms
PC Desktop		162.16 ms	105.81 ms	184.47 ms

Table 6: XKMS message ValidateRequest

Device	RSA key length (bits)	Host name of XKMS service, n=1000 iterations		
		www.infrax.si	ca.halman.net	ca.clhs.kiev.ua
Mobile Phone	1024	225.74 ms	203.35 ms	223.48 ms
PC Desktop		175.09 ms	165.69 ms	187.77 ms
Mobile Phone	2048	236.11 ms	212.13 ms	227.2 ms
PC Desktop		185.81 ms	167.31 ms	191.84 ms
Mobile Phone	3072	277.39 ms	213.86 ms	234.06 ms
PC Desktop		190.91 ms	169.59 ms	198.37 ms
Mobile Phone	4096	285.32 ms	228.21 ms	239.06 ms
PC Desktop		196.08 ms	194.06 ms	198.72 ms

Some observations of the presented experimental analysis are:

- The operation of digital signature of XML message (XML-Signature mechanism), using 2048-bit private RSA key, takes 95.87 ms on mobile phone. It means that in one second, 10 operations of generation XML-Signature can be implemented by using 2048-bit private key pair component.
- Operations of creation of appropriate request message, communication with TimeStamp Server and processing its response message takes on mobile phone from 179.30 ms (using HTTP protocol) to 906.80 ms (using SSL over HTTP protocol).
- Operations of creation of appropriate XKMS request messages (LocateRequest, ValidateRequest), communication with XKMS Server and processing its response message takes on mobile phone from 136.48 ms (using LocateRequest message) to 285.32 ms (using ValidateRequest message).

These observations could lead to the conclusion that mobile phone could be used in real time for implementation of digital signature operations, communication with TSA and XKMS servers in times comparable to the ones obtained on PC computers.

7. – Conclusions

In this paper, we presented a usage of possible secure model of m-government systems in cross-border scenarios as well as an analysis of possibility and feasibility of using secure Android-based web service mobile application in it. Presented experimental results justify that security operations related to XML/WSS digital signature/verification, communication with TSA and XKMS servers are feasible for usage on some current smart phones. Thus, we could conclude that this application could serve as a basis for implementing secure m-government system based on the model described in this paper that

could be used in cross-border m-government scenarios. Future researching directions in domain of m-government systems are:

- Full implementation of secure mobile Web service applications for all other mobile platforms (JAVA, iPhone, BlackBerry, Windows Phone).
- Full implementation of advanced electronic signature formats (e.g. XAdeS, PAdeS).
- Integration of PKI SIM technology in the secure mobile client Web service application.
- Application based (Android, JAVA, iPhone, Windows Phone) digital signature by using the asymmetric private key on the PKI smart cards and usage of the integrated NFC (Near Field Communication) security element as a smart card reader.
- Using the proposed secure model for other PKI based e/m-government services (strong user authentication to other e-government web portals, signing documents prepared through some other communication channels, qualified signatures, etc.).

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COMBINING PROCESS MODELLING AND CASE MODELLING

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Abstract – Adaptive Case Management deals with processes that are not predefined or repeatable, but depend on evolving circumstances and decisions regarding a particular situation. While case management is often considered as different from conventional business process management, in reality they cannot be strictly separated. A structured business process can contain parts which deal with non-routine cases. The Object Management Group (OMG) published the Business Process Model & Notation (BPMN) as well as the Case Management Model & Notation (CMMN). There is an ongoing debate whether these two languages should be combined are kept independent.
After a short introduction into CMMN and BPMN we analyse an application process as it is typical for public administration in order to identify strengths and weaknesses of both BPMN and CMMN. We show that typical processes contain both structured and non-structured parts and neither BPMN nor CMMN alone is adequate to model the process. Finally, we propose recommendations for a meta-model, which combines elements of BPMN and CMMN.

1. – Introduction

The benefits of Business Process Management (BPM) --reduction of cycle time, automation of routine processes, standardization and compliance, business integration and end-to-end performance visibility-- are well established in many companies and public administrations. However, an important class of business processes has been unable to enjoy them: case management[3] [1]. Case management processes are not predefined or repeatable, but instead, depend on evolving circumstances and decisions regarding a particular situation, a case [2]. Human judgment is required in determining how to proceed [3].

Case management processes are a common occurrence in public administrations and many industry segments. In a case management survey it was observed that two third of a knowledge worker's day is spent in unstructured and often unpredictable work patterns [4]. In government we can find case management in particular in decision processes, where human judgment is required. It is well established in many segments of benefits administration, like disability, welfare assistance, student financial aid and grants programs [1].

Adaptive Case Management (ACM) has been proposed as alternative data-centred approach for the management of such case processes [2], in contrast to the activity-centred approaches for structured business processes [4]. However, while case management is often considered as different from conventional business process management (see [4]), in reality they cannot be strictly separated. A structured business process can contain parts which deal with non-routine cases requiring additional investigation by different people, for example the underwriting in financial services [1]. Nevertheless, in 2013 the OMG published the new Case Management Model and Notation (CMMN) [5], a modelling

[3] Also called Adaptive Case Management (ACM)

language specific for case management which is separate from Business Process Model and Notation (BPMN) [6], which is a standard for business process modelling.

In this research we investigate, whether and how business process modelling and case modelling should be integrated. We analyse a concrete case and show that neither BPMN nor CMMN alone are appropriate to model all aspects. We analyse the commonalities and differences of BPMN and CMMN and suggest an integrated meta-model that allows to model structured and non-structured aspects of a business process in a single environment.

2. – Related Work

Adaptive Case Management (ACM) has recently received growing attention [7]–[9]. In this section the differences between Adaptive Case Management (ACM) and Business Process Management (BPM) are briefly described.

BPM focuses on business processes consisting of activities in a flow. According to The business process defines the flow of control, all the possible paths and permutations are defined in advance [4]. As an activity occurs, the state of the process changes (see Figure 1). As the state changes, it is transferred from one activity to the next, control flows similarly from one activity to the next.

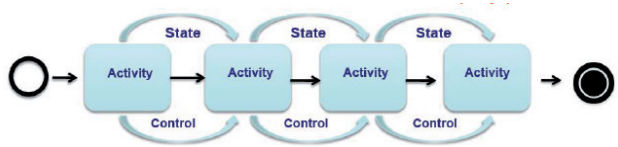


Figure 1: States in BPM [10]

ACM, on the other hand, focuses on cases consisting on events and outcomes. More precisely a case is a collection of processes and isolated tasks, the number and identity of which cannot be fixed by a predefined template or rules. While the circumstances , which define how and when the case is completed are known, it is not possible to fully predetermine all the tasks needed to complete the case, as stated by Palmer [4]. A case evolves over time in the direction of achieving a goal and it can take unpredictable directions. The activities to reach the completion of the case are determined by the content and context and each of them creates information to add to the case. This defines the state of a case as shown in Figure 2. In particular where human judgment is predominant, ACM is a more appropriate approach.

Figure 2: States in ACM [10]

Modelling cases has specific requirements compared to process modelling, because with ACM sequence and pathways of execution are not predetermined [4]. In the standard process modelling

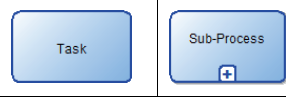
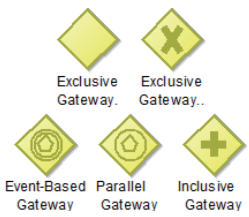
language BPMN there is the possibility to indicate subprocesses [6] as adhoc, but there is no further support to express specific aspects of cases. As a consequence, the OMG developed the Case Management Model and Notation CMMN [5] as a separate modelling language.

There is an ongoing debate whether a new modelling language is necessary for case management or whether case modelling can be an extension of business process modelling. While Swenson claims that "BPMN is incompatible with ACM" [11], Silver argues that BPMN and CMMN should be merged [12]. He proposes to extend BPMN with case-specific element of CMMN. To illustrate his argument, he shows an example with case elements added to BPMN. Also IBM works on a case extension of their business process modelling in tool [13] offering the possibility to add discretionary tasks in business processes, instantiating them at runtime either manually by a user or by a few defined preconditions. In other words IBM's BPM 8.5.5 seamlessly blends runtime and non runtime processes, and all combinations thereof, in a single product. Other approaches combine CMMN and BPMN in the same tool by reusing model elements (see for example [14]). In contrast, we focus on developing an integrated language with elements from both CMMN and BPMN.

3. – Overview of BPMN and CMMN

In this section we give a short overview of BPMN [6] and CMMN [5]. This section is not intended as an introduction into the languages but serves as a reference.

For convenience we show in Table 1 the main elements of BPMN, which can be divided into 4 categories: flow objects, connectors, artefacts and swimlanes. The focus of BPMN is to model the control flow of business processes (with flow objects and sequence flow connector), the assignment of activities to participants (using swimlanes) and information flow (using data objects and message flow).

Element Name	Element Icon	Element Description
Flow Objects		
Activities		An activity is work that is performed within a business process. There are 2 types of activities: **Tasks** which are units of work and **Sub-Processes which** are activities that can be refined.
Events		Events are states that affect the flow of the process; one can distinguish Start, Intermediate or End Events. They can trigger activities (catching) or are its result (throwing).
Gateways		Gateways represent points of control: they split and merge the flow of a process: **Exclusive Gateways** route the sequence flow to exactly one of the outgoing branches. **Event-based Gateways** route to the subsequent event which happens first. **Parallel Gateways (AND)** activate all outgoing branches. **Inclusive Gateways (OR)** activate at least one branch.

Connectors		
Sequence Flow		A Sequence Flow is used to show the order that activities within a Pool.
Message Flow		Interaction between Pools is handled through **Message Flow**.
Association		Data Associations connect Data Objects to Activities.
Artefacts		
Data Object		Artifacts provide the capability to show information beyond the basic flow-chart structure of the Process. Data Objects can be used to define Inputs and Outputs of activities or Data Stores which represent repositories or databases.
Swimlanes		
Pool		A pool is a container for a business process or a participant in a collaboration
Lanes		A lane is an optional subdivision of a process level. They are typically used to associate process activities with particular actors. Each participant that performs activities in a business process has a lane. A lane can represent a role, an organizational unit or a system.

Table 1: BPMN Modeling Elements

The modeling elements of CMMN are shown in Table 2. Case management allows planning of tasks at run-time. This can be modelled in CMMN using discretionary tasks. The worker can add one or more instances of discretionary tasks to the plan [5, p. 14f]. Planning tables support the human worker in planning. A planning table contains applicability rules for the discretionary tasks. During planning only Discretionary Items, for which the Applicability Rule evaluates to “true”, must be shown to the Case Worker.

Control flow in CMMN is not modelled via gateways but via Sentries. A Sentry is assigned to task, stages and milestone. A Sentry is a combination of an event and a condition. When the event is received, a condition is checked. If the condition evaluates to true, the Plan Item is activated.

Element Name	Element Icon	Element Description
Case Plan Model		The behavior of a Case is captured in a **Case Plan Model**. For each Case model, a Case Plan Model is required and it comprises all elements that represent the initial plan of the case as well as all elements that support the further evolution of the plan through run-time planning by case workers.
Plans Items		

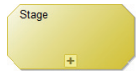
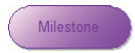
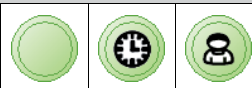
Task		A Task is **a unit of work**. Task can specialized into **three types of Tasks.** Tasks can be specialized to **human tasks, case tasks** (calling another case) and **process tasks** (call to a business process)
Discretionary Task		**Discretionary Tasks** are available to the Case worker to be applied to his/her discretion. Any task type can be discretionary. They are depicted like tasks but with dashed lines.
Plan Fragments/Stages		
Plan Fragment		A Plan Fragment is a container of Plan Items and Sentries.
Stage		Stages are Plan Fragments that can be tracked. They may be considered "episodes" of a Case.
Milestones		
Milestone		A Milestone is a Plan Item Definition that represents an achievable target, defined to enable the evaluation of the progress of the Case.
Event Listeners		
Event Listener		An event is something that "happens" during the course of a Case. Event Listeners are used to model events that do not happen to Plan Items. They can be specialized as: **Timer** or **User** Event Listeners.
Other Items		
Planning Table		The **planning tables** make the Discretionary Items dynamically applicable for planning. Only Discretionary Items, for which the Applicability Rule evaluates to "true", are shown to the Case Worker.
Sentries		Plan Items may have associated Sentries. They define the criteria according to which the Plan Items are enabled (or entered) and terminated (or exited). If depicted by a shallow "Diamond" they are **entries** and if depicted by a solid "Diamond" they are **exits**.
Case File		All information, or references to information, that is required as context for managing a Case, is defined by a Case File. A Case File onsists of Case File Items that may represent a piece of information of any nature, ranging from unstructured to structured, and from simple to complex.
Connector	.....	A Connector has the shape of a dotted line and it can be used to visualize dependencies between Plan Items.

Table 2: CMMN Modeling Elements

4. – Case Study - Application Processes in Public Administration

In this section we present a case study to demonstrate the necessity of combining case management and business process management in public administrations.

In public administrations we often find processes where citizens or companies file an application that has to be handled by human workers. Examples are applications for building permission, social welfare, student financial aid, or grants programmes. Many of these processes can be regarded as knowledge work [15]. Thereby, workers are often involved in different cases at the same time and collaborate with each other in order to achieve a common goal [16].

As an example of such an application process we analyse the admission process for the Master of Science programmes at the School of Business FHNW.

- The process starts when the application from a candidate is received.
- First the study assistant checks eligibility of the candidate.
- The dean validates the eligibility as proposed by the study assistant.
- Candidates who obviously are not eligible are rejected. The other candidates are invited for an interview, which is made by the interview team.
- Then the admission commission decides whether the candidate is accepted.
- For accepted candidates the administration determines the tuition fee.
- The study assistant informs the candidate about acceptance and tuition fee.

This process can be represented in BPMN as given in Figure 3.

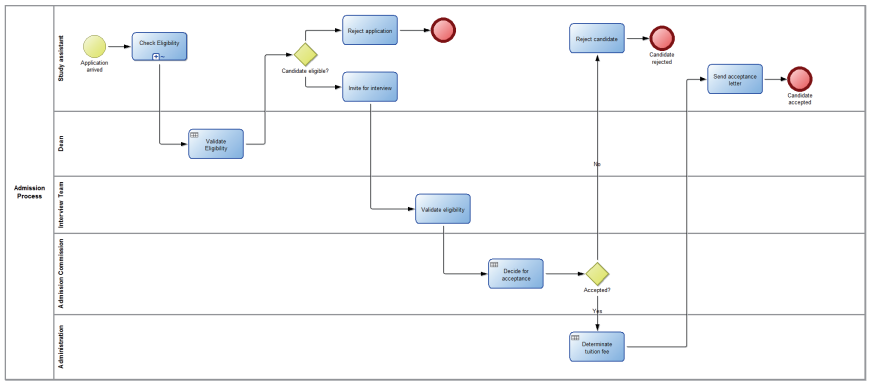


Figure 3: Application Process in BPMN 2.0

Check Eligibility is an adhoc subprocess which consists of the following tasks:

- The study assistant checks for completeness of the documents.
- The candidate's transcript of records is analyzed to determine whether the bachelor degree is acceptable and whether the average grade is at least "good".

- If the grading system is from a foreign university, it has to be mapped to the Swiss grading system.

- It is checked whether the university, from which the candidate got the bachelor degree, is accredited. If the university is unknown, the study assistant can access several information sources he/she can ask public authorities in the country to confirm the status of the university.

In this sense the application process is a good example to compare the adequacy of BPMN and CMMN. It contains elements that are typical for both BPM and ACM. The main process is a standard routine process. It follows a predefined flow, thus the use of BPMN is an appropriate choice.

However, modelling the Check Eligibility subprocess in BPMN reveals some problems. It is a non-routine process consisting of activities whose execution depends on the situation as well as the competences and experiences of the person who executes the tasks. For example, it is up to the study assistant, who executes the activity “Check Accreditation of University”, which activities need to be performed and whether additional steps are required. If the study assistant already knows the university which an applicant comes from (maybe from a previous case) he/she would not need to access any information sources for the university checking. Conversely, if the study assistant does not know the university and he/she is not able to find information about it in any of the proposed information source, he/she can decide to follow additional procedures or to find new information sources in order to get the information needed. Thus, human judgment is required in determining how to proceed.

Furthermore, the order of the tasks is not fixed, tasks can overlap and they can depend on each other. If for example, the study assistant finds out during the task "Analyse Application Documents" that the bachelor degree is acceptable, the tasks "Analyse Transcript of Record" is not necessary anymore.

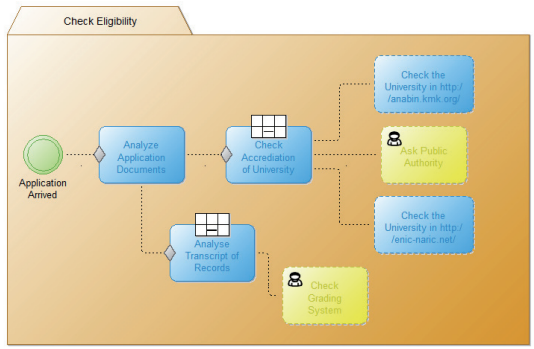


Figure 4: Check Eligibility in CMMN

For this non routine part of the process we need another kind of modelling. CMMN would allow to model this subprocess by using discretionary tasks and Sentries (see Figure 4). In particular the discretionary tasks, whose execution depends in the individual human worker, cannot be modeled adequately in BPMN.

5. – Appropriateness of BPMN and CMMN for Modeling the Application Process

The case study presented in section 4 has been modelled by a combination of BPMN and CMMN. The overall process is modelled in BPMN while for the sub-process CMMN was regarded as adequate. In this section we have a more detailed look at the model. We show present arguments for the separation of the model and also explain advantages and limitations of each of the modelling languages.

5.1 – Modeling Control Flow in BPMN and CMMN

In BPMN the order of activities is modeled with a dedicated arrow for the sequence flow. In CMMN there is only one type of relation. To model a sequence flow, the connector associates a tasks with the Sentry of the successor task. A Sentry is a combination of an event and a condition. The task is triggered when the event is received and the condition evaluates to true. Thus, the BPMN sequence flow on the left of Figure 5 and the CMMN connection on the right of Figure are equivalent, if the condition of the Sentry is either empty or always true.

Figure 5: Modeling sequence flow in BPMN and CMMN

The conditions of a Sentry can also be used to model gateways. To model an exclusive gateway in CMMN, the Sentry conditions of the subsequent gateways must be exclusive. Thus, the process flow of the admission process in Figure 3 could be modeled in CMMN. But while in BPMN it can be directly whether a gateway is exclusive, in CMMN this is hidden in the Sentries.

As a consequence, BPMN is preferable for modeling structured processes. Although the flow of a process can also be modeled in CMMN, the meaning of the connection is hidden in the Sentry. Thus, the graphical model in CMMN is less expressive than a BPMN model.

5.2 – Assigning Tasks to Roles

The lanes in BPMN visualize, who is responsible for which activity. Lanes can represent organisation units, roles or systems. In the admission process the lanes are used to assign tasks to the study assistant, the dean, the interview team and the administration.

CMMN is lacking a visual modeling element for assigning tasks to roles. Instead, CMMN has a role concept. Roles in CMMN authorize case workers or teams of case workers to perform Human Tasks, plan based on Discretionary Items, and raise user events [5]. The assignment of tasks to roles, however, is not visualized but represented via attributes of tasks.

5.3 – Discretionary Tasks

Sections 5.1 and 5.2 show some advantages of BPMN for modeling structured processes and for assigning tasks to people. However, BPMN does not have a specific expression to model tasks, whose execution depends on the judgment and preference of the worker. In BPMN all tasks are integrated in a sequence flow. Whether a task is executed depends on conditions about data or on events.

We could use gateways. In the same situation it can happened that one worker would execute an activity but another would not need to execute the activity because of his/her experiences or knowledge. This kind of dependence on the individual worker is not typical use of gateways.

For cases, however, planning tasks at runtime is typical. In the subprocess Check Eligibility (see Figure), the human worker can decide at runtime whether he/she want to access an information source for checking the accreditation of a university. He/she might have a preference for a specific source, maybe because of an more or less intuitive interface. If the human worker already knows the university, he/she might decide not to access an information source at all. This can be modeled in CMMN with discretionary task (see Figure 5).

However, individually adding and selecting tasks might be appropriate also in a structured process. An example is the task "Decide for acceptance". Although it is part of the structured BPMN process, the human workers - dependent on their individual skills and experiences - can do additional research to decide the case. This would be possible to model as discretionary tasks in CMMN which are not available in BPMN.

5.4 – Modeling Decision Logic

In the process model of Figure 4 we see several processes which are tagged as business rules tasks. These tasks are decision tasks and the business rules represent the decision logic. Von Halle and Goldberg provide arguments why separating the decision logic from the process flow is good modeling style [17]. Decision logic could be represented as busienss rules, or as a decision model [17]. Business rules tasks are appropriate to link process model and decision logic. Business rules tasks are available in BPMN but lacking in CMMN.

6. – Proposal for a combined Process and Case Modeling Language

The analysis of the previous Section revealed that neither CMMN nor BPMN alone are able to model the application process of the case study in a suitable way. As a consequence, we propose to specify a modeling language that combines elements of the two modeling languages. From the analysis we derived the following requirements for the combined business process and case modeling language:

- The language should allow visualizing the control flow. This makes process flow easy to understand and support the communication with the different stakeholder of a process. The sequence flow connector and the gateways of BPMN are suitable for making the control flow explicit.

- Lanes are a commonly accepted approach to visualize the assignment of tasks to participants (roles, organization units and systems).

- It should be possible to connect discretionary tasks to any kind of human task - even those embedded in a structured process flow. This allows knowledge workers to flexibly

- It should be possible to model tasks which are not embedded in a process flow and which can be triggered at any time based on events and conditions. Sentries of CMMN are adequate to satisfy this requirement.

- BPMN and CMMN have different types of tasks. The new language should include the task types of both BPMN and CMMN. In particular, business rules tasks should be part also of non-structured process part.

- Three types of rules should be supported by the modeling languages:

    - business rules representing decision logic which is applied while executing a task

    - activation rules that determine whether a task is triggered -this corresponds to the Sentries of CMMN

    - applicability rules support the human user in planning the discretionary task

Silver has argued that BPMN covers about 90% of what is needed for business processes [13]. Following his argument, it would be a good approach to start with BPMN and add the necessary case aspects. If BPMN would be a subset of the new language, the huge number of already existing BPMN models could still be used. This is an important advantage and would increase the chance that the new language is accepted by process managers.

7. – Conclusion

We have shown that in practice neither Case Management nor Business Process Management alone are adequate to deal with application processes, which are typical for public administrations. While BPMN is suitable to model control flow, it lacks possibilities to support planning at run-time. The latter, however, is the strength of CMMN. But CMMN lacks the visualization of control flow and task assignments.

A combination of the control flow elements of BPMN with the discretionary tasks and planning elements of CMMN seems to be a suitable language to deal with any kind of processes. A concrete specification and implementation of such a modeling language will be the challenge for future research.

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EGOVERNMENT BREAKDOWN: THE CITIZEN PERSPECTIVE FOR A SUSTAINABLE INNOVATION

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After more than 10 years of Italian eGovernment, despite substantial investments, a strong legislative support and the high technological level, major obstacles are still present in Local PA, which inhibit the establishment of eGovernment. These critical issues are confirmed on the one hand by the limited offering diffusion and on the other hand by the citizens' low usage of services; indeed, the latter is one of the lowest in Europe, as remarked in the research carried out by Eurostat. Nonetheless, this state of the art is not always confirmed by benchmarking studies in the field of eGovernment at international level, where Italy occupies always a good position, especially in recent years.
Hence, a relevant gap emerges between the evidence related to the unripe development of eGovernment initiatives in Italy and the international rankings. This shows an apparent contrast between the current applications of the benchmarking technique, and its potential as a tool to support strategy. Current benchmarking models in eGovernment field have, thus, different issues and, failing to provide a representative picture of the current stage of maturity, they can't reach the typical advantages of benchmarking, which stimulate the continuous improvement and promotion of successful behaviour patterns and of virtuous guidelines. The present research is aimed at deeply analysing factors that determine the maturity of eGovernment, to define the variables that the conceptual framework should monitor in order to support sustainable innovation. In this paper eGovernment is defined as mature when on the one hand the supply of services is widespread, on the other hand when it is used by citizens. Thus, two indicators have been developed: the level of paybacks achieved and the multi-channel maturity. The proposed framework allows to measure eGovernment maturity, and thanks to the consistency with benchmarking rules, contributes to stimulate sustainable innovation, identifying guidelines for continuous improvement.

1. - Introduction

In recent years, undeniable progresses have been registered regarding the use of ICT by the Public Administration (PA), both in terms of services provided and infrastructures. Basing on literature review and empirical analysis, this paper focuses on the Italian environment, which seems to be characterised by an apparent dichotomy between the international eGovernment ranking and the actual offer of services [1].

Italian PAs have been involved for several years in a modernisation process based on technological innovation, completely aligned with a global phenomenon, which has in Europe common lines of action and strategies. According to Istat [2], Italy is placed above the European average in terms of public services available online, though the quality and completeness of its offer is still heterogeneous. Nonetheless, even though Information and Communication Technologies are well spread within the Institutions [3] [4], this is not enough to assure an effective offer of eGovernment services, which require a process reengineering to optimise relations between users and PA.

So, after more than 10 years of Italian eGovernment, today it can be stated that in Italy it has not taken off yet, and citizens and enterprises use of online services provided by Public Institution is among the

lowest in Europe. During 2011, the percentage of people using eGovernment services in Italy was about 22%, one of the lowest in Europe, which conversely has an average of approximately 41%. Even though the value of the same rate, varies for enterprises, the meaning and implications are similar, since the percentage of Italian companies using eGovernment services is about 76%, while the EU average is 85% [5].

The analysis of the international benchmark studies does not seem to confirm the scenario described above. Indeed, Italy gets excellent marks in the assessment of the level of development of eGovernment initiatives: in the 2010 edition of the EU eGovernment Benchmarking carried out by Capgemini on behalf of the European Commission, the availability of online services results in line with the European average, while its level of complexity is higher, reaching 99% [6]. In 2012, the annual survey of the United Nations gives to Italy an eGovernment index 72%, placing it 32nd in the global ranking [7].

These considerations point out a significant gap between the evidence relating the availability of the eGovernment services in Italy and their actual use. This apparent inconsistency may be related to two factors: (i) the benchmarking models promoted by intergovernmental bodies, such as those mentioned above, may have different goals than to stimulate innovation through the promotion of best practice; (ii) the tools which are used to detect the eGovernment maturity may be based on a set of indicators that fail to provide a reliable representation of the state of the art.

Therefore the present research is aimed at carrying out an in-depth analysis of the variables that determine the eGovernment development and the key factors of a sustainable innovation, in order to define a theoretical framework for measuring the eGovernment maturity level.

The first phase of the research had provided an analysis in order to understand the theory of benchmarking and its applications in eGovernment field.

From the analysis of critical issues it was possible to deduce which factors should be considered in the reference framework for measuring the eGovernment services maturity level, in order to figure out the main variables relevant for the purposes of benchmarking, with regard to the promotion of the best practices and the optimization of investment in eGovernment initiatives.

However, it was necessary to understand which are the variables that affect the use and diffusion of eGovernment services. After careful analysis of the literature on these themes, it was decided to directly detect which are the main issues and needs of local authorities engaged in innovation initiatives, as well as those of the citizens that interface with them.

2. - Research methodology

In order to support the framework definition, the research started out with an exploratory approach, aimed at collecting LPA difficulties in eGovernment projects, and understanding citizens' point of view. Therefore two different surveys were carried out, as this methodology represents an accurate instrument for gathering information within an extended group of subjects [8].

An initial web based survey was distributed to 918 PA during November 2012, with a response rate of 17%, to investigate needs and difficulties faced by PA in implementing innovation projects. In October 2011 a telephone interview addressed to 1.000 Italian citizens, representing a significant sample of the national population, was carried out in order to understand their needs and expectations. Afterward, the identified framework has been applied to fines procedure in Italian context. This procedure involves many actors in different stages, and in recent years it's characterized by a progressive process of digitalization and dematerialization, in order to gain efficiency and effectiveness. This procedure has been investigated through a qualitative case study methodology, necessary to have a prior view of the

object of the analysis [9], [10]. In particular case studies have been aimed at identifying activities and resources involved in each phase of fines procedure and define critical variables in innovation process.

Then another web based survey was distributed to 3.442 PA during December 2012 – February 2013, with a response rate of 15%, in order to collect the variables needed to estimate the indicators of fines service maturity.

3. - Literature Review

3.1. - Benchmarking Process

Benchmarking allows to increase and improve self-awareness and assessment, providing solid basis for strategic actions: indeed, the process of sharing and comparing with the goal of self-analysis may increase the effectiveness and efficiency thus reducing resistance to change, since the involvement contributes to the creation of consensus while formulating objectives.

In order to provide added value to the analysed processes, and to contribute to the performance maximisation, with regard to the promotion of best practices able to bring optimisation, benchmarking should be characterised by several aspects that, according to the processes specific priorities, would vary in their strength. As stated by Huppler [11], these aspects or requirements are: relevance, repeatability, fairness, verifiability and economically sustainable. To build a good benchmark, a careful planning of the objectives would be required. The theory of planning and developing key success factors, or KPI (Key Performance Indicators) identifies five criteria that objectives and goals should have [12]: specific, measurable, accessible, relevant, time-based.

According to the classical theory of Management Control System [13], the requirements of the objectives underlying the definition of Key Performance Indicators should be characterized by: long-term orientation, completeness, accuracy, timeliness, measurability, compliance with the specific responsibility, economic sustainability.

Compliance with the variables described can guarantee the identification of a well-structured benchmarking tool, able to support the organization's activities, to promote innovation and improvement, through the dissemination of best practices.

3.2. - eGovernment Maturity Models

In eGovernment literature there are several studies aimed at identifying the steps of digitalization process in PA, which emphasize different organizational and technological challenges.

First, there are several research on the maturity of the context (eReadiness), focused not only on the readiness of the infrastructure, but also on government and citizens' one for eGovernment initiatives' introduction [14] [15] [16].

Then, there are studies that focus on back-office digitization, analysing the availability and use of ICT, and methods of internal and external coordination in PA [17], [18]. In particular, it can be classified from two different observation point: the supply, measured by online presence of the PA [7], [17], [19], [20], and the demand, analysed referring on citizen use of online services [21], [22]. Finally, there are advanced researches analysing economic, political, and sociological impacts of digitization [15], [23].

Despite these manifold aspects, actually the approaches to eGovernment benchmarking are mainly focused on just one of the areas, the digitization of the front-office on the supply side [24], [25].

	Online Presence		Online Interaction	Back-office Integration	Front-office integration		eParticipation	
Baum and Di Maio (2000)	Presence		Interaction	Transaction	Transformation			
Layne and Lee (2001)	Catalogue			Transaction	Vertical integration	Horizontal integration		
Hiller and Bélanger (2001)	Information dissemination		Two-way communication	Transaction	Integration		Participation	
Howard (2001)	Publish		Interact	Transact				
Wescott (2001)	Internal network	Information dissemination	Two-way communication	Exchange of value			Digital democracy	Joined-up government
United Nations (2002, 2010)	Emerging	Enhanced	Interaction [removed in UN 2010]	Transaction	Seamless			
Moon (2002)	Information dissemination		Two-way communication	Transaction	Vertical and horizontal integration		Political participation	
Accenture (2003)	Online presence		Basic capability	Availability	Mature delivery	Transformation		
Siau and Long (2004)	Online presence		Interaction	Transaction	Integration and transformation		Digital democracy	
West (2004)	Billboard stage		Partial service-delivery		Integration		Interactive democracy	
Capgemini et. al. (2004, 2007)	Information	One-way interaction	Two-way interaction	Transaction	Personalization [added in Capgemini 2007]			

Table 5: Maturity Models

3.3. - eGovernment Benchmarking

The potential of benchmarking as a tool for learning, information sharing, and goal setting or supporting performance management has been recognized since the 1980s (Bullivant, 1994), but it is mainly from the 2000s that benchmarking in eGovernment issue has received growing interest. Moving to the actual Italian scenario, it seems not to be confirmed by international benchmark studies, which are based on indicators that do not respect principles of benchmarking; therefore these researches cannot support the decision maker in strategic planning.

3.4. - eGovernment diffusion

Four critical issues limit the diffusion of eGovernment services:

- Resources: availability of financial resources is the main problem felt by local authorities, which generate the lack of other resources, such as skills [27] [28] [29] and expertise. Furthermore, the implementation of eGovernment projects requires fixed investments [30] [31], which if not sustained over time, frustrate efforts.
- Organization: fragmentation of roles, management discontinuity, difficulties of coordinating with actors involved [32], make project management complicated, because the body can not act autonomously, but must interface with many parts that have visions and goals uncoordinated [33], [34], [35], [36].
- Culture: [37] [38] [39] resistance to change [40], [41] represents a big brake in the diffusion of innovation [42], [43], [44]. Users play a significant role in improvement process, and if not motivated, can generate resistances difficult to overcome; only involving all the stakeholders, innovation can work successfully [45].
- Legislation: legislation ought to coordinate, [46] simplify and enhance eGovernment, nevertheless it still represents a relevant limit, because of the bureaucracy that de-motivates and discourages initiatives.

In this framework digitization is crucial because it represents an important source of efficiency that allows benefits' generation. As the financial resource is the critical resource, PA should focus its efforts in optimizing investments.

In addition, PA investing in innovation should consider citizens' preferences, in order to reflect a citizen-centric approach, where users' needs must represent the guidelines for digitization and innovation projects.

4. - Maturity Model

4.1. - Reference context

Thorough an extended literature review on the theory and applications of eGovernment benchmarking, it has been possible to identify three factors influencing the diffusion of digital public services and their use: Background, PA's characteristics, users' attitudes [47].

The background is a necessary condition to develop eGovernment services. However, it's by definition an exogenous factor and therefore cannot be changed from a PA who invests in innovation. This factor is important for a complete benchmarking, but measure eReadiness go beyond the purpose of this paper. Therefore, this research is focused on the other two factors that affect the diffusion of eGovernment.

4.2. - PA's characteristics

The survey carried out about Innovation Management in PA reveals the critical issues currently limiting the diffusion level of eGovernment services as identified in literature, such as Resources, Organization, Culture, Legislation.

However not all critical issues can be overcome through actions under the control and the decision making capability of each PA. Indeed, cultural and legislation issues represent aspects which are partially intangible and difficult to monitor entirely, as they may be influenced by subjective or environmental factors, and thus, PA can manage only marginally through its operative and decisional levers. Nonetheless these issues could affect the realization of an eGovernment project and the consequential diffusion of the related innovative services, therefore, since they may be considered as exogenous factors with regard to the context under analysis, it was decided to take them in consideration as a given parameter to monitor by the eReadiness indicator of the Country.

Conversely, Resource Availability and Organisational Structure are aspects that can be influenced by the policies and decisions of each Entity about using its resources in order to innovate its services addressed to users.

In particular, if there are savings in terms of time and costs for an Administration and for its employees, it will be possible to make innovation more sustainable, limiting negative effects relative to resources' lack, and making change more acceptable, indeed , frequently it is thwarted in order to perverse the status quo of an organization feeling threatened by the introduction of new work process. First of all, eGovernment is an organizational change process, so it needs different implications' management on involved human resources. They could perceive innovation as a duty that increases workloads, needing time and efforts to be introduced. In addition, digitalization could be obstructed: procedures' standardisation could be seen as a limitation of each one role or, in case of complete computerization, as technologies replacing human resources. However, it is possible to assert that, having recourse to a systematic and rational approach to innovation, resistance to change decreases, but it is necessary to breed resources and to move them to surplus value activities. In addition, investments' rationalisation, resources' involvement in innovation process and patency of tangible efforts increase eGovernment initiatives' definition reducing the relinquishment of innovation projects even if human resources managing it change. eGovernment services' diffusion gets necessarily through to innovation sustainability [48]: only returns in terms of efficiency generated by management and processes' digitalization could be able to promote and support eGovernment initiatives. Benefits'

level arising from digitalization represents the variable able to monitor innovation sustainability, first of all from an economic point of view, in terms of reached efficiency. However, the indicator shows how efficiency produces savings and how these latter, when are produced, are able to guarantee resources in order to manage investments and invest in competences and exploitable other resources.

4.3. - Users' point of view

The Computer Assisted Telephone Interview (CATI) addressed to citizen highlight which factors may affect innovative service utilization. In particular, citizens express a desire for convenient services, accessible fast and with low costs for the user, and quality services, that is responsive to their needs.

Furthermore citizen express multi-channel desire, they would like to access the same service through different systems depending on the occasion.

Considering these aspects, a Public Administration that wants to increase the innovative services usage, has two different levers: (i) make services more accessible (convenient), less expensive in terms of time and costs [49], [50]; (ii) make services more attractive (quality), that is enrich services with features in order to make it interesting for citizen [51], [52], [53], [54].

Therefore, for each channel it is possible to identify an indicator of accessibility and attractiveness. Furthermore PA should respond to citizens' need for multi-channel delivery, offering services through multiple channels.

Thus, eGovernment maturity, in terms of the ability of services to respond citizens' needs, can be measured by: (i) the maturity of the multi-channel services, when the PA has made available services across all channels desired by its users; (ii) the maturity of each channel, when the PA has provided to services all the characteristics of accessibility and attractiveness required by citizens.

4.4. - The proposed maturity model

The maturity of eGovernment services can be measured by: (i) the level of advantages from digitalization gained [55]; (ii) the maturity of multi-channel services offered [56].

The first indicator measures the effort accomplished in each micro phase of innovation process. The level of advantages achieved is a synthetic indicator of efficiency, and measures the paybacks obtainable from investments in digitalization process.

The second indicator used to describe the maturity of eGovernment services measures the level of maturity of the multi-channel. This indicator provides two information: on one hand, the number of channels offered to the citizen, on the other hand, how each channel meets users' needs. The indicator represent a synthetic indicator of effectiveness, thus it is possible to enhance the study, analysing each channel maturity.

eGovernment is defined as mature when on the one hand the supply of services is widespread, on the other hand when it is used by citizen. Thus, two indicators have been developed, the level of paybacks achieved and the multi-channel maturity.

A developed eGovernment service takes advantage from digitalization and it is offered on different channel.

eGovernment refers to the use by government agencies of information and communication technologies, in order to serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, cost reductions [57], [58].

This paper refers to eGovernment as the way to improve efficiency and effectiveness in managing public procedure. The focus is on bureaucratic and administrative service, because they represent a significant part of PA, which does not provide value added services to the citizen, but is just perceived as a burden. In particular the analysis is focused on one administrative service: fines procedure in Italian context.

Collecting data from Local PA has been possible to identify maturity level of the fines procedure (Figure 1).

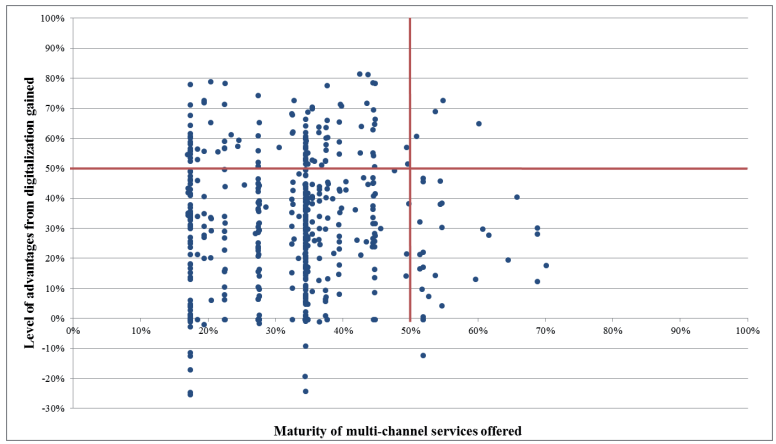

Figure 1: Italian fines service maturity

In Figure 1 it is represented the map of fines service maturity in the sample analysed.

Immediately appears as the majority of respondents (73.1%) should still work a lot to be able to achieve digitalization payback and user satisfaction through multi-channel offer. A mature service is still a marginal phenomenon strongly (0.8%), and represents today a best practice.

However, a quite large part of PAs interviewed (20.6%) achived important part of digitalization advantages, and now they should work at increasing the effectiveness of the offer through a multi-channel approach.

5. - Conclusion

In order to respond to the weaknesses identified in current eGovernment benchmarking models and to support PA to invest in innovation, has been identified a new framework to measure the maturity of eGovernment, which overcomes the limitations of existing measurement systems.

Therefore, it is possible to compare factors that should characterize a benchmarking tool with the proposed framework and to models analysed in literature (Table 6).

	Literature Models	***Proposed framework***
Specificity	***Low***	***High***
Relevance	***Low***	***High***
Completeness	***Low***	***High***

Accuracy	***Low***	***High***
Timeliness	***Medium***	***Medium - High***
Measurability	***Medium***	***High***
Repeatability	***Low***	***Low***
Verifiability	***Medium***	***Medium***
Economic sustainability	***Medium***	***Medium***

Table 6: Benchmarking factors: comparison between Literature Models and Proposed framework

The proposed framework allows to measure eGovernment maturity, and thanks to the consistency with benchmarking rules, contributes to stimulate sustainable innovation, identifying guidelines for continuous improvement. The follow-up of this research could consider a wider PA' sample, trough the extension of the analysis to the national level, in order to have a more complete picture and get more specific information. Future researches should study the variables determining the use of different channel by citizen. In this way, it would be possible to make accurate considerations on the current maturity level of a service to understand, through cluster analysis methodology, which factors drive innovation development.

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